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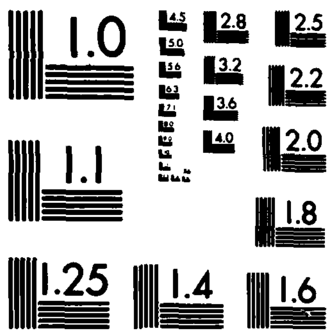

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AFWAL-TR-82-2019
VOLUME IV

USAF ADVANCED TERRESTRIAL ENERGY STUDY

VOLUME IV: ANALYSIS, DATA, AND BIBLIOGRAPHY

Institute of Gas Technology
3424 S. State Street
Chicago, Illinois 60616

April 1983

FINAL REPORT SEPTEMBER 1980-FEBRUARY 1982

Approved for public release; distribution unlimited

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AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved for publication.

DOUGLAS M. ALLEN
Project Engineer

PAUL R. BERTHEAUD
Chief, Energy Conversion Branch
Aerospace Power Division
Aero Propulsion Laboratory

FOR THE COMMANDER

JAMES D. REAMS
Chief, Aerospace Power Division
Aero Propulsion Laboratory

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Diesels	Wind Turbines	Photovoltaics
Fuel Cells	Organic Rankine Cycles	Batteries
Gas Turbines	Stirling Engines	Thermal Energy Storage

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents the results of the USAF Advanced Terrestrial Energy Study. The objective of that study was to develop a data base of key parameters of selected energy conversion and energy storage technologies. The data base includes present and expected (through 2000) performance goals of the systems. The data base was established through an extensive literature search, surveys of manufacturers and researchers, and statistical and qualitative analyses of the available input data. The results of the study are reported in the following four documents:

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Technical Report: Final Report, Volume I, Project Summary

Technical Report: Final Report, Volume II, Technology Handbook

Technical Report: Final Report. Volume III, Parameter Survey

Technical Report: Final Report, Volume IV, Analysis, Data, Bibliography

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INTRODUCTION

A variety of energy systems are undergoing research and development and may provide such benefits as reduced costs, greater reliability, and greater flexibility relative to conventional commercially available energy systems. This effort was funded to develop a data base of the key parameters of selected systems to serve as input to a multiple-criterion decision computer model which identifies the most appropriate energy technology for different Air Force needs.

The objective of this project was to develop a data base of technical and economic performance parameters of selected energy conversion and energy storage devices. The data base includes not only the state-of-the-art (1980) values of the performance parameters but also the expected values of the performance parameters in the 1985, 1990, and 2000 time frame. For the energy conversion technologies, the performance parameters were developed over the power output range from 1.5 kW to 5000.0 kW. For the energy storage technologies, the performance parameters were developed over the energy output range equivalent to the power output at continuous annual operation.

The energy conversion technologies characterized in this data base are:

- Gas Turbines
  - Open cycle, non-recuperative (non-regenerative)
  - Closed cycle
  - Open cycle, recuperative (regenerative)
- Diesels
  - Turbocompounded
  - Turbocharged
  - Adiabatic
- Stirlings
  - Free piston
  - Kinematic
- Organic Rankine Cycles

- Fuel Cells
  - Phosphoric acid
  - Solid Polymer Electrolyte (SPE)
  - Molten carbonate
- Photovoltaics
  - Flate plate
  - Actively cooled
  - Photochemical
- Wind Turbines
  - Vertical-axis
  - Horizontal-axis

The energy storage technologies characterized in this data base are:

- Batteries
  - $Zn/C\ell_2$
  - Zn/Br_2
  - Ni/Fe
  - $Li\text{-}Al/FeS_2$
  - Na/S
  - Advanced Sealed Lead Acids
  - Redox Cr-Fe
- Thermal Energy Storage Devices
  - $Ca\ C\ell_2 \cdot 6\ H_2O$, Calcium Chloride Hexahydrate
  - $Na_2SO_4 \cdot 10\ H_2O$, Sodium Sulfate Decahydrate (Glauber's Salt)
  - $Na\ S_2O_3 \cdot 5\ H_2O$, Sodium Thiosulfate Pentahydrate
  - Olivine Ceramic Brick
  - Magnisite Ceramic Brick
  - Form-stable Polyethylene

This volume contains the analysis, raw data, and bibliography that led to the data base of the technologies. Each datum is referred to the source in the bibliography. The analytical methods are discussed in Volume I, Project Summary. Note that the original analyses were conducted in a logarithmic base (log of the output) to facilitate the use of the curve-fitting algorithm. Therefore, all figure in this volume use the log of the output level as the x-axis.

GAS TURBINE ENERGY CONVERSION SYSTEMS

Analysis

Open Cycle, Non-Recuperative (Non-Regenerative)

Data have been obtained for determination of values for parameters of efficiency, acquisition cost, operation and maintenance cost, weight, volume, footprint, start-up/shutdown time, and lifetime. Data used in analysis of these parameters are presented in Table 1.

Applying appropriate data analysis techniques resulted in the following functions for these parameters.

Efficiency of Open Cycle Gas Turbine Energy Conversion Systems (GTEFF)

$$GTEFF\ (\%) = 11.29252 \log_{10} x - 0.96985 (\log_{10} x)^2 \quad (1)$$

Standard Deviation = 1.42

x = kW

Equation 1 and corresponding data are shown in Figure 1.

Acquisition Cost of Open Cycle Gas Turbine Energy Conversion Systems (GTACQ)

$$GTACQ\ (\$/kW) = 1815.216\ x^{-0.23814} \quad (2)$$

Standard Deviation = 0.124

x = kW

Acquisition cost data availability is limited. Equation 2 and corresponding data are shown in Figure 2.

Operation and Maintenance Cost of Open Cycle Gas Turbine Energy Conversion Systems (GTOM)

$$GTOM\ (\$/yr) = 90.73783\ x^{0.7619604} \quad (3)$$

x = kW

Operation and maintenance cost data availability is limited.

Weight of Open Cycle Gas Turbine Energy Conversion Systems (GTW)

$$GTW\ (lb/kW) = 2.890 \quad (4)$$

Standard Deviation = 1.03

No dependence of GTW on size (kW). Considerable scatter of data.

Table 1. DATA USED IN ANALYSIS OF PARAMETERS OF EFFICIENCY, ACQUISITION COST, OPERATION AND MAINTENANCE COST, WEIGHT, VOLUME, FOOTPRINT, STARTUP/SHUTDOWN TIME, AND LIFETIME OF OPEN CYCLE GAS TURBINE ENERGY CONVERSION SYSTEM

Capacity (kW)	Efficiency (%)	Acqusition Cost ($/kW)	Operation and Maintenance Cost ($/yr)	Weight (lb/kW)	Volume (ft^3/kW)	Footprint (ft^2/kW)	Startup Time/ Normal Shutdown Time/Efficiency Shutdown Time	Lifetime (Years)
252					0.16667			
350					5.7143×10^{-2}			
380					5.2816×10^{-2}			
505				3.4653	7.1287×10^{-2}			
520	21.0			3.3654	6.9281×10^{-2}			
530	22.0	424.53	11,250	3.2264	0.10000	0.12736	1.0 min/2.0 min/ 10.0 sec	20.0
548	22.0			3.1204	9.6715×10^{-2}			
800	21.0							
1,450						8.6897×10^{-2}		
1,470		289.12	21,280	4.0816	0.17211		1.0 min/2.0 min/ 10.0 sec	20.0
2,550	26.0							
2,800	25.0				0.51071			
2,960		287.16	42,500	2.9730	0.18919	6.4885×10^{-2}	1.5 min/3.0 min/ 10 sec	20.0
3,066	27.0							
5,110	30.0							
7,400	31.0				0.51757			
9,750	32.0							
10,200	32.0							
18,900				1.6825	0.43069			
20,000				3.9000	0.12705			
20,100				1.0945	0.37711			
24,900				3.7349				
34,850	30.0							
35,650	31.0			1.4811	0.32954			
49,800				3.7349				
60,000	31.0				0.74233			
61,750	31.0				0.42740			
72,900	32.0							
75,000	32.0				0.35189			
102,700	32.0							
105,600	32.0							

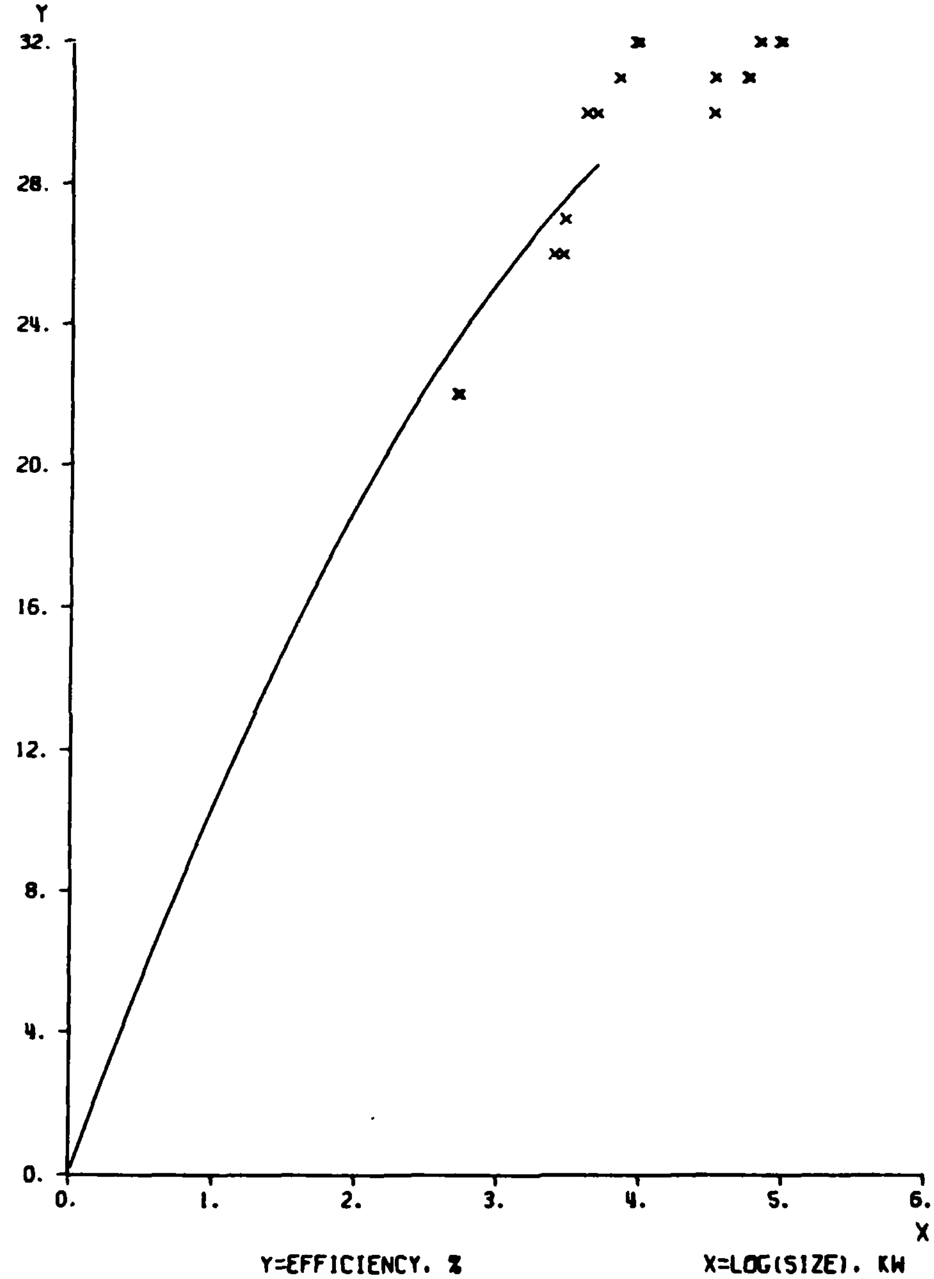


Figure 1. EFFICIENCY OF OPEN CYCLE GAS TURBINE ENERGY CONVERSION SYSTEMS

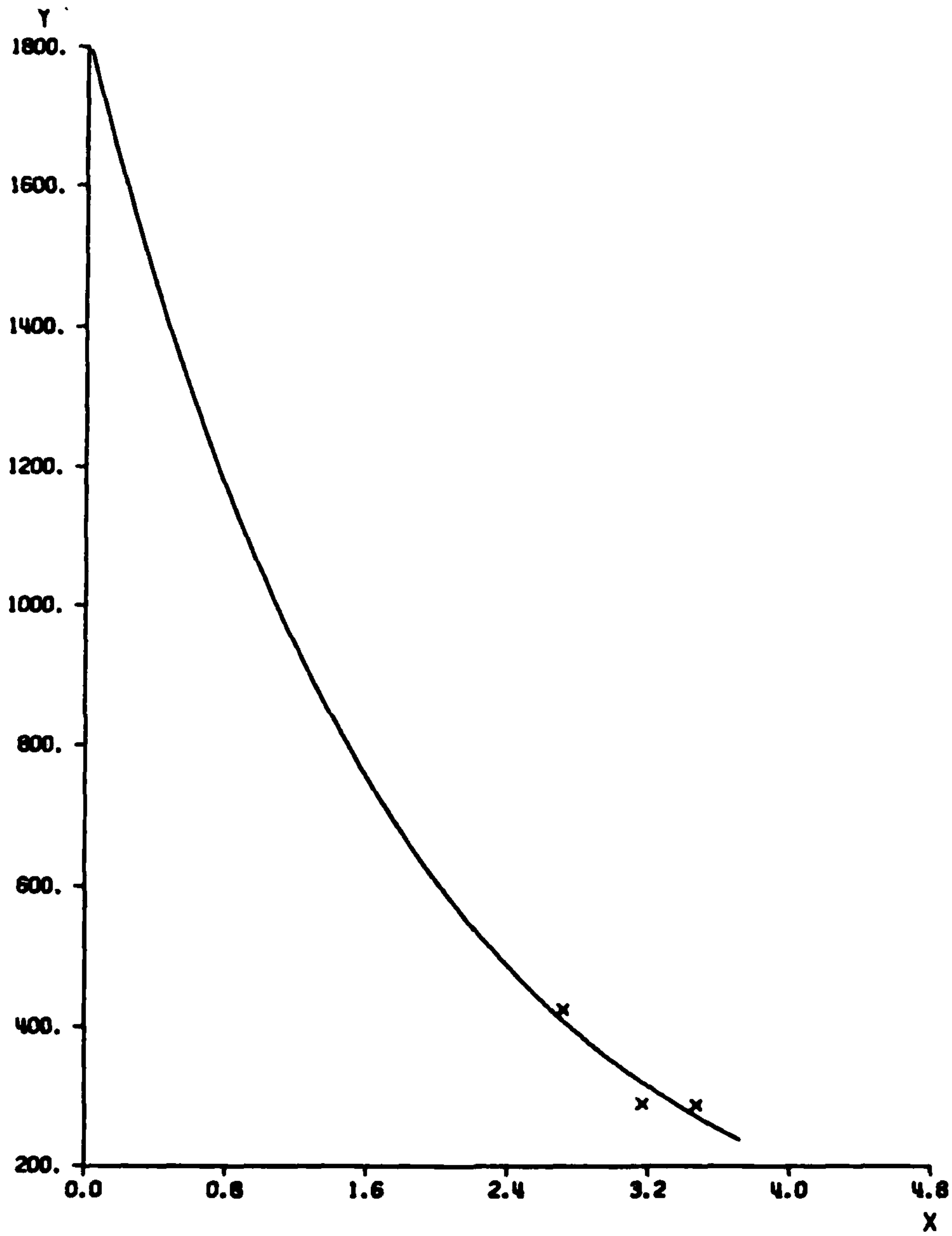


Figure 2. ACQUISITION COST OF OPEN CYCLE GAS TURBINE ENERGY CONVERSION SYSTEMS

Volume of Open Cycle Gas Turbine Energy Conversion Systems (GTV)

$$GTV\ (ft^3/kW) = 0.01287\ x^{-0.33036} \quad (5)$$

Standard Deviation = 0.529

x = kW

At small sizes (kW), negative standard deviation values lead to meaningless negative values for volume. Use positive standard deviation values for small sizes. Equation 5 and corresponding data are shown in Figure 3.

Footprint of Open Cycle Gas Turbine Energy Conversion Systems (GTF)

$$GTF\ (ft^2/kW) = 1.4899\ x^{-0.391444} \quad (6)$$

Standard Deviation = 0.0102

x = kW

Footprint data availability is limited. Equation 6 and corresponding data are shown in Figure 4.

Start-Up Time of Open Cycle Gas Turbine Energy Conversion Systems (GTST)

GTST = 1.0 minute (7)

Equation 7 and corresponding data are shown in Figure 5.

Normal Shutdown Time of Open Cycle Gas Turbine Energy Conversion Systems (GTSH)

GTSH = 2.0 minutes (8)

Equation 8 and corresponding data are shown in Figure 6.

Emergency Shutdown Time of Open Cycle Gas Turbine Energy Conversion Systems (GTESH)

GTESH = 10 sec (9)

Start-up/shutdown time data are limited. Equation 9 and corresponding data are shown in Figure 7.

Lifetime of Open Cycle Gas Turbine Energy Conversion Systems (GTLF)

GTLF = 20 years (10)

Lifetime data availability is limited.

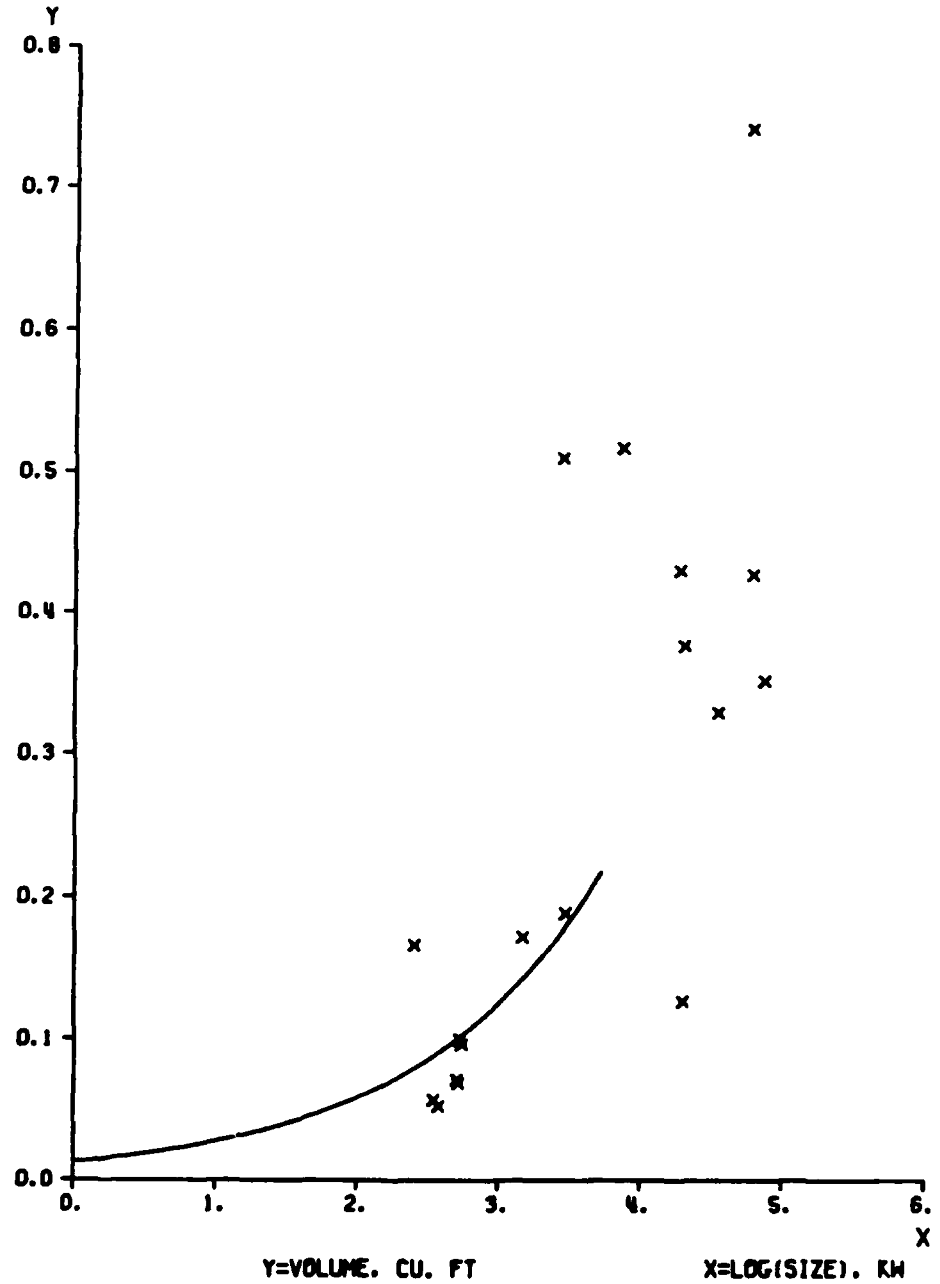


Figure 3. VOLUME OF OPEN CYCLE GAS TURBINE ENERGY CONVERSION SYSTEMS

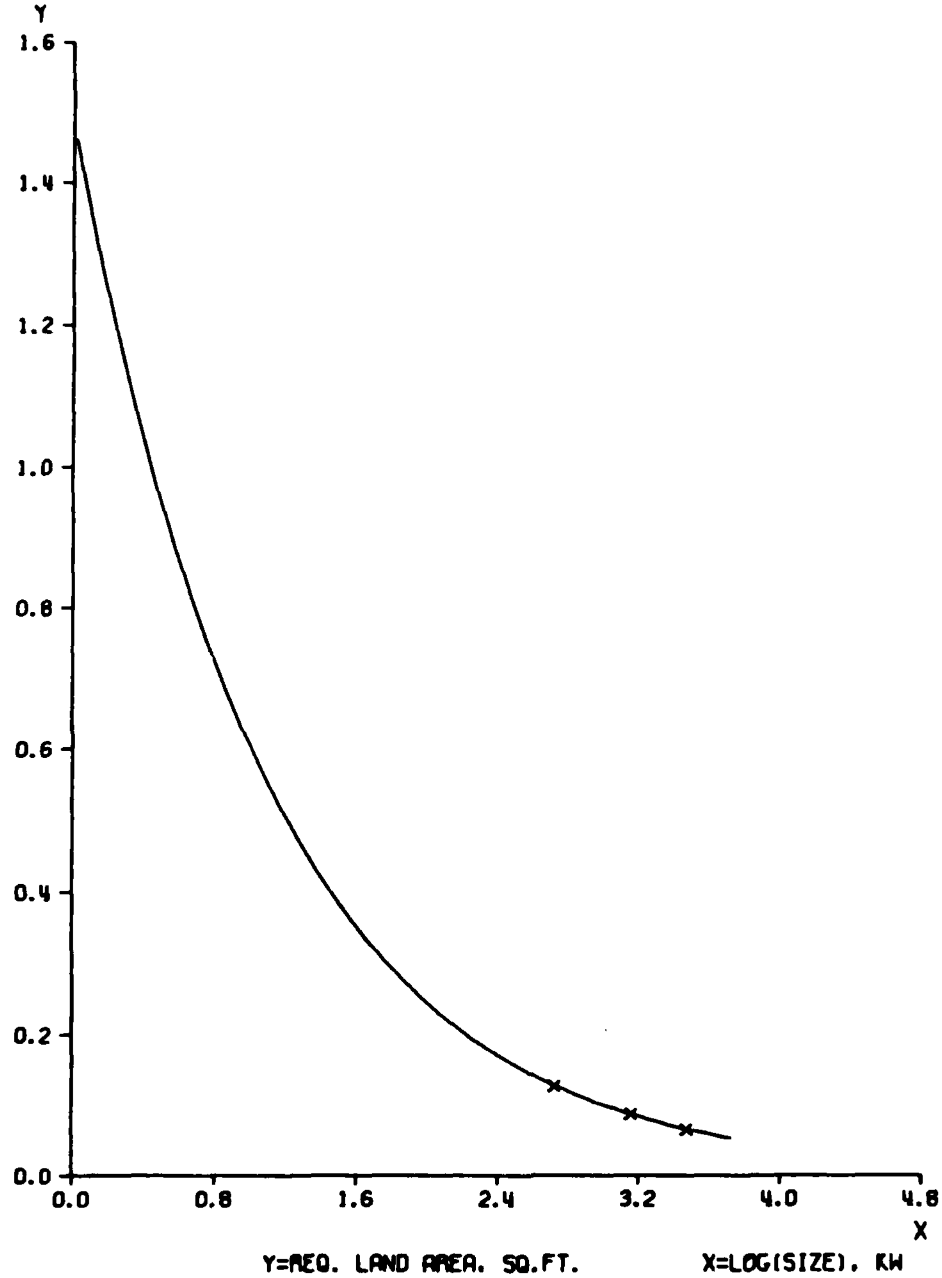
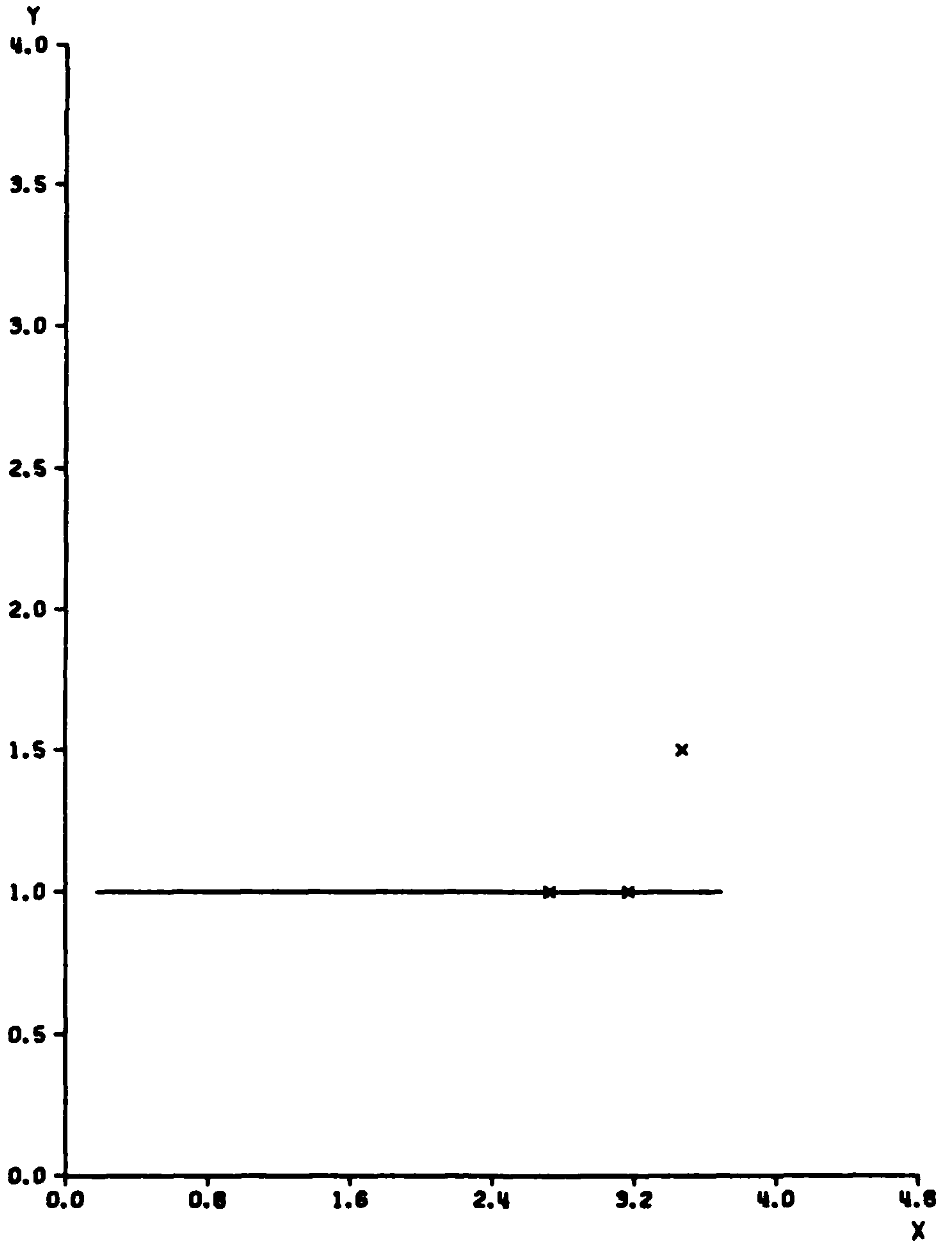
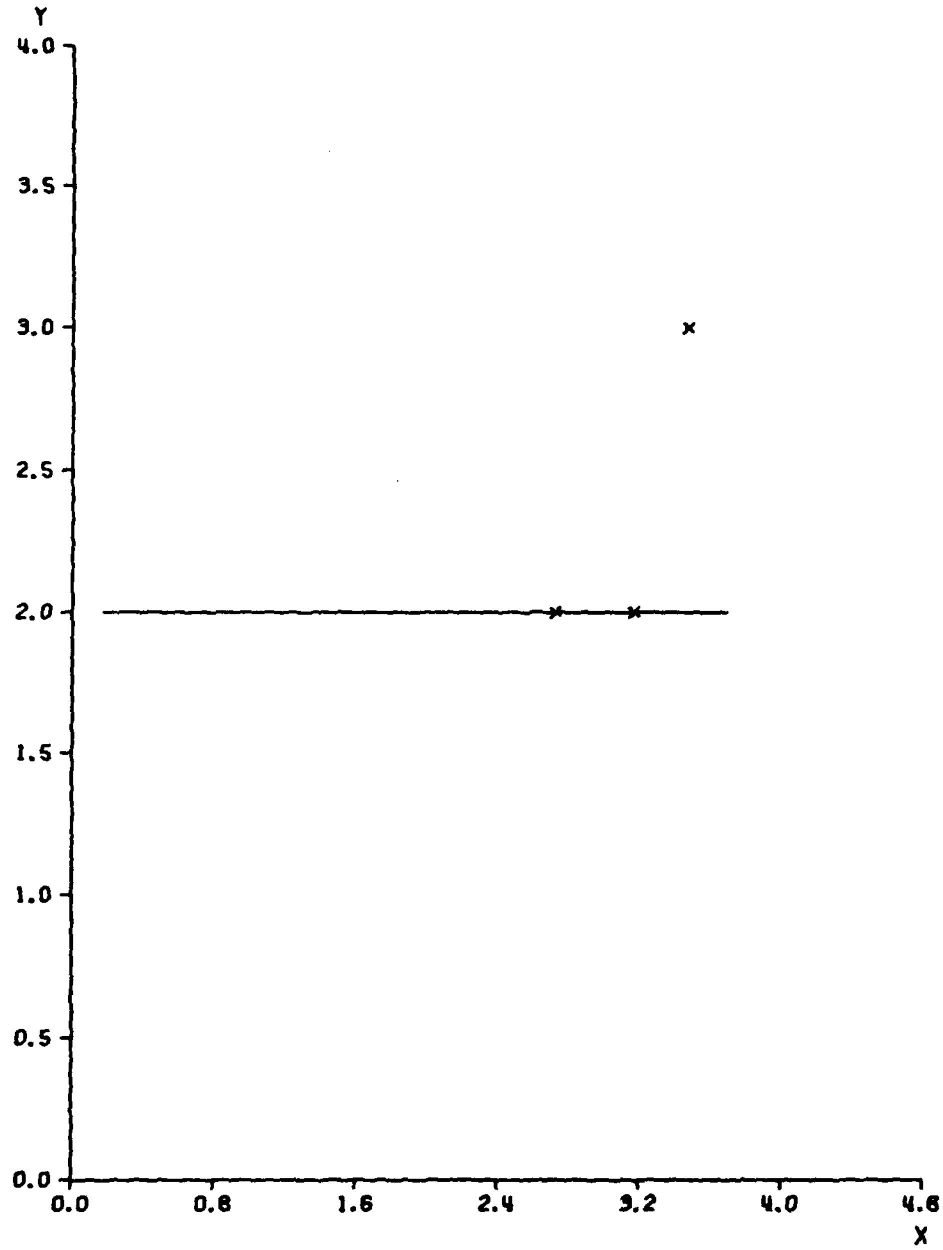


Figure 4. FOOTPRINT OF OPEN CYCLE TURBINE ENERGY CONVERSION SYSTEMS



Y = START-UP TIME, MIN X = LOG (SIZE), KW

Figure 5. START-UP TIME OF OPEN CYCLE GAS TURBINE ENERGY CONVERSION SYSTEMS



Y = NORMAL SHUTDOWN TIME, MIN X = LOG (SIZE), KW

Figure 6. NORMAL SHUTDOWN TIME OF OPEN CYCLE GAS TURBINE ENERGY CONVERSION SYSTEMS

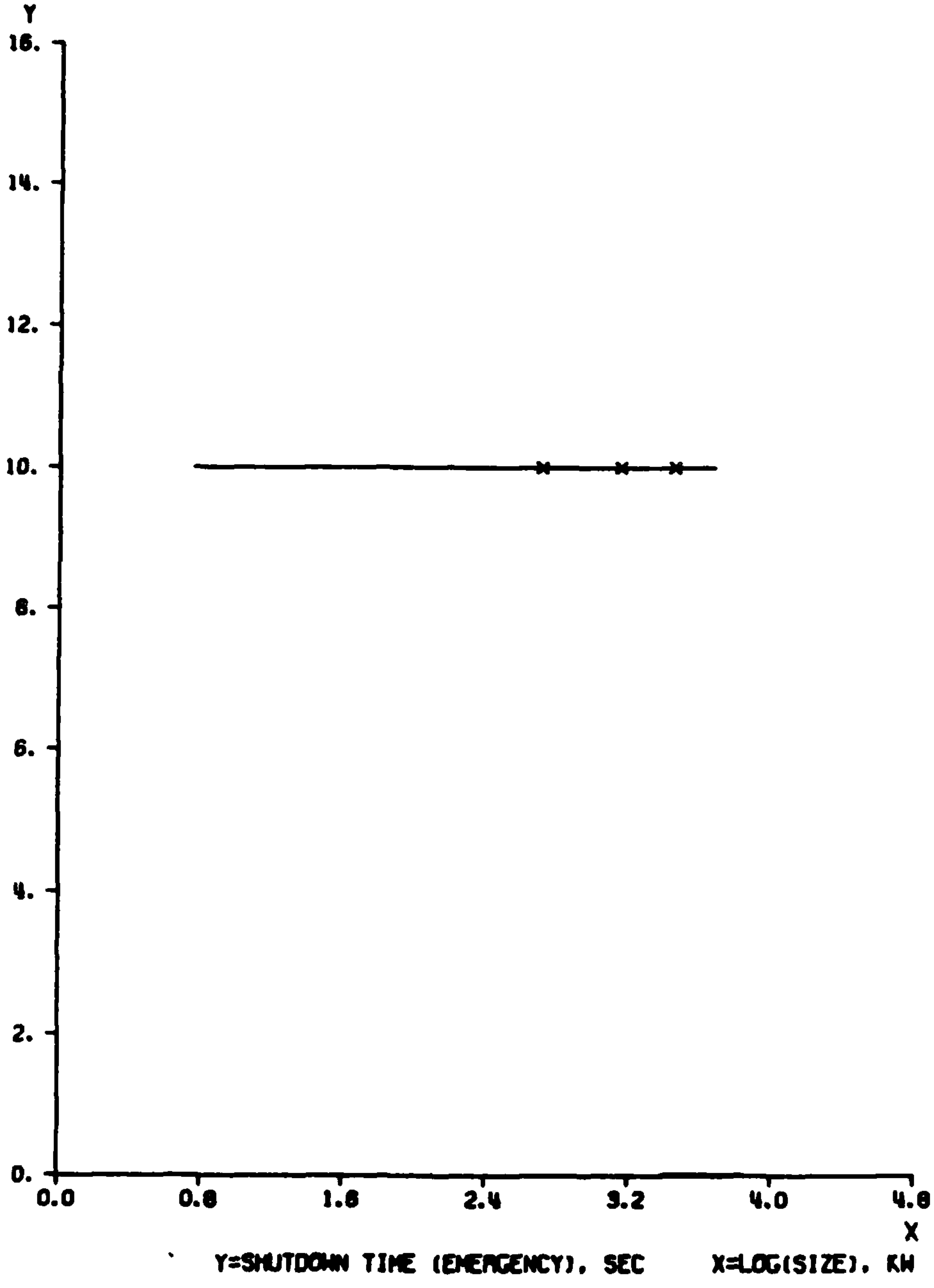


Figure 7. EMERGENCY SHUTDOWN TIME OF OPEN CYCLE GAS TURBINE ENERGY CONVERSION SYSTEMS

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 2 through 5.

Values of the open-cycle gas turbine energy conversion system parameters for selected system sizes (kW) as predicted from Equations 1 through 10 are presented in Table 6.

Table 2. GAS TURBINE (Open-Cycle) ENERGY CONVERSION SYSTEM LOCATION CONSTRAINTS

Constraints	Effects	Remarks
1. Water Requirements	--	
2. Manning Requirements	--	Fully automated
3. Fuel Availability and Delivery	●	Must be located near natural gas pipeline or LNG facility
4. Fuel Storage	●	Storage is part of pipeline system or expensive LNG tank
5. Other	0	Metropolitan siting may be difficult because of noise and NO_x emissions.

Overall Assessment: The ordinal score is 3 indicating average locational constraints.

Table 3. GAS TURBINE (Open-Cycle) ENERGY CONVERSION SYSTEM RELIABILITY CONSTRAINTS

Constraints	Effect	Remarks
1. Moving Parts	●	Numerous moving parts
2. Operating Temperature	0	
3. Modularity of the Design	●	System is non-modular
4. Stress Levels	0	
5. Corrosion	0	
6. Other	0	Subject to thermal cycling

Overall Assessment: The ordinal score is 3 indicating average reliability.

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Table 4. GAS TURBINE (Open-Cycle) ENERGY CONVERSION SYSTEM OPERATION CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability	0	Lower efficiency and increased emissions at part loads
2. Overload Capability	0	
3. Load Following Capability	0	

Overall Assessment: The ordinal score is 4 indicating moderate turn-down capability; moderate efficiency penalty.

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Table 5. GAS TURBINE (Open-Cycle) ENERGY CONVERSION SYSTEM
ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	●	O	●	Limited to vicinity. Generates large volumes of waste-heat gases.
• Air Pollution				
CO	—	—	—	
NO_x	●	O	●	Considerable NO_x generation
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Others	—	—	—	
• Noise	●	●	●	Inherently noisy because of expanding hot gases.
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 4 indicating moderate potential environmental constraint.

Table 6. VALUES OF THE OPEN CYCLE GAS TURBINE ENERGY CONVERSION SYSTEM PARAMETERS FOR EFFICIENCY, ACQUISITION COST, OPERATION AND MAINTENANCE COST, WEIGHT, VOLUME, FOOTPRINT, STARTUP/SHUTDOWN TIME, AND LIFETIME AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

Energy Conversion System Size (kW)	(Equation 1) Efficiency (%) ± 1.42	(Equation 2) Acquisiton Cost ($/kW) ± 0.124	(Equation 3) Operation and Maintenance Cost ($/yr)	(Equation 4) Weight (lb/kW) ± 1.03	(Equation 5) Volume (ft^3/kW) ± 0.529
1.5	2.0	1650	124	2.89	0.015
5.0	7.4	1240	309	2.89	0.022
20.0	13.1	889	889	2.89	0.035
30.0	14.6	808	1,210	2.89	0.040
60.0	17.0	685	2,050	2.89	0.050
100.0	18.7	606	3,030	2.89	0.059
250.0	21.5	487	6,090	2.89	0.080
750.0	24.5	375	14,080	2.89	0.115
1000.0	25.2	350	17,530	2.89	0.126
5000.0	28.5	239	59,740	2.89	0.215
10000.0	29.7	202	101,300	2.89	0.270

Energy Conversion System Size (kW)	(Equation 6) Footprint (ft^2/kW) ± 0.0102	(Equation 7) Startup Time (min)	(Equation 8) Shutdown Time Normal (min)	(Equation 9) Shutdown Time-Emergency (sec)	(Equation 10) Liftime (Years)
1.5	1.270	1.0	2.0	10	20
5.0	0.793	1.0	2.0	10	20
20.0	0.461	1.0	2.0	10	20
30.0	0.393	1.0	2.0	10	20
60.0	0.300	1.0	2.0	10	20
100.0	0.245	1.0	2.0	10	20
250.0	0.171	1.0	2.0	10	20
750.0	0.112	1.0	2.0	10	20
1000.0	0.100	1.0	2.0	10	20
5000.0	0.053	1.0	2.0	10	20
10000.0	0.040	1.0	2.0	10	20

GAS TURBINE ENERGY CONVERSION SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Gas Turbine-Open Cycle

Parameter: Efficiency, %

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
G. 174, 175		36	252	
		19	350	
		19	380	
		21	505	
		21	520	
		22	530	
		22	548	
		21	800	
		17	1470	
		22	1835	
		26	2550	
		26	2950	
		23	2960	
		25	2800	
		27	3066	
		30	4327	
		28	4512	
		30	5110	
		31	7400	
		32	9750	
		32	10200	
		26	18900	
		35	20100	
		35	20000	
		27	24110	
		29	24900	
		30	34850	
		31	35650	
		29	49800	
		31	60000	
		31	61750	
		32	72900	
		32	75000	
		32	102700	
		32	105600	

DATA SHEET

Energy Conversion System: Gas Turbine-Open Cycle

Parameter: Volume, Ft^3

Energy Conversion System Ref.	Parameter Value: Study	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
			0-1000	
G. 174, 175		42	252	
		20	350	
		20	380	
		36	505	
		36	520	
		53	530	
		53	548	
		1070	800	
			1000-2000	
		253	1470	
		60	1835	
		60	2550	
		60	2950	
		560	2960	
		1430	2800	
		56	3066	
		176	4327	
		29	4512	
		29	5110	
		3830	7400	
		8320	9750	
			≥10000	
		8320	10200	
		8140	18900	
		7580	20100	
		2541	20000	
		3630	24900	
		290530	34850	
		11748	35650	
		7260	49800	
		44540	60000	
		26392	61750	
		290530	72900	
		26392	75000	
		241900	102700	
		241900	105600	

DATA SHEET

Energy Conversion System: Gas Turbine-Open Cycle

Parameter: Weight,Lb

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
G. 174, 175			0-1000	
		1800	252	
		350	350	
		369	380	
		1750	505	
		1750	520	
		1710	530	
		1710	548	
		20250	800	
			1000-2000	
		6000	1470	
		1185	1835	
		1275	2550	
		1325	2950	
		8800	2960	
		40000	2800	
		1270	3066	
		7490	4327	
		1350	4512	
		1490	5110	
		140000	7400	
		242000	9750	
			>10000	
		242000	10200	
		31800	18900	
		22000	20100	
		78000	20000	
		93000	24900	
		700000	34850	
		52800	35650	
		186000	49800	
		1095000	60000	
		587000	61750	
		1070000	72900	
		587000	75000	
		142500	102700	
		142500	105600	

DATA SHEET

Energy Conversion System: Gas Turbine-Open Cycle

Parameter: Required Land Are, Ft^2

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
G. 176		126	1450	
		192	2960	
		67.5	530	

DATA SHEET

Energy Conversion System: Gas Turbine-Open Cycle

Parameter: Startup Time/ Shutdown Time (Normal)/Shutdown Time (Emergency) (Minutes)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
G. 176		1/2/10	1470	
		1.5/3/10	2960	
		1/2/10	530	

DATA SHEET

Energy Conversion System: Gas Turbine-Open Cycle

Parameter: O&M Cost $/year (not including overhead and fuel) (1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
G. 176		21,280	1470	
		42,500	2960	
		11,250	530	

DATA SHEET

Energy Conversion System: Gas Turbine-Open Cycle

Parameter: Acquistion Cost, $ (1980)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
G. 176		425,000	1470	
		850,000	2960	
		225,000	530	

DATA SHEET

Energy Conversion System: Gas Turbine-Open Cycle

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
G. 176		20 years	1470	
		20 years	2960	
		20 years	530	

DATA SHEET

Energy Conversion System: Gas Turbine-Closed Cycle

Parameter: Efficiency, %

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
G. 196	39		2500	Fluidized bed, recuperator
G. 190	31		30	

GAS TURBINE ENERGY CONVERSION SYSTEMS

Bibliography

G-1

ACCESSION NO.	79R0116771
TITLE(MONO)	ADVANCED COAL-FUELED COMBUSTOR/HEAT EXCHANGER TECHNOLOGY STUDY. FINAL REPORT. MARCH 1977—JUNE 1978
CORPORATE AUTH	ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA (USA). ROCKETDYNE DIV.
PAGE NO	331
AVAILABILITY	DEP. NTIS. PC A15/MF A01.
CONTRACT NO	CONTRACT EF-77-C-01-2612
DATE	1978
CATEGORIES	EDB-200102
PRIMARY CAT	EDB-200102
REPORT NO	RI/RD—78-212A
ABSTRACT	THIS REPORT IS CONCERNED PRINCIPALLY WITH THE DESIGN OF COAL-FIRED COMBUSTOR/HEAT EXCHANGERS SUITABLE FOR INPUTTING THE HEAT TO BASE-LOADED, CLOSED-CYCLE, GAS TURBINE, 350 MWE, CENTRAL STATION POWER GENERATION SYSTEMS. A WIDE VARIETY OF CCGT CYCLES ARE EVALUATED TO ESTABLISH THE PERFORMANCE REQUIREMENTS FOR THE COMBUSTOR/HEAT EXCHANGER. THE CYCLES FINALLY SELECTED FOR COMBUSTOR/HEAT EXCHANGER DESIGN OPERATE AT 1550, 1750, AND 2250 F MAXIMUM WORKING-FLUID TEMPERATURES. AT THE 1550 F MAXIMUM WORKING-FLUID TEMPERATURE, TWO COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGNS ARE CREATED, ONE UTILIZING THE PULVERIZED-COAL-FIRED, DRY-BOTTOM FURNACE FIRING CONCEPT AND THE OTHER UTILIZING THE ATMOSPHERIC-PRESSURE, FLUIDIZED BED WITH LIMESTONE ADDITION FIRING CONCEPT. IN BOTH DESIGNS, ALL HEAT EXCHANGER SURFACE IS METAL. AT THE 1750 F MAXIMUM WORKING-FLUID TEMPERATURE, THE COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGN IS BASED ON A SERIES ARRANGEMENT OF HIGH- AND LOW-TEMPERATURE FLUIDIZED BEDS. AT 2250 F MAXIMUM WORKING-FLUID TEMPERATURE, THE COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGN IS BASED ON THE SLAGGING CYCLONE COMBUSTOR CONCEPT. HEAT EXCHANGER SURFACE EXPOSED TO WORKING-FLUID TEMPERATURES ABOVE 1550 F IN THE LAST TWO DESIGNS IS CONSTRUCTED OF SILICON CARBIDE. THE KEY TECHNICAL FEATURES OF THE FOUR PRELIMINARY DESIGNS ARE IDENTIFIED AND ANALYZED. RESEARCH AND DEVELOPMENT PROGRAMS TO ADVANCE THE TECHNOLOGY OF THESE DESIGNS TO A STATE OF READINESS FOR COMMERCIAL APPLICATION ARE OUTLINED, AND R AND D COST ESTIMATES ARE PRESENTED. THE COST OF ELECTRICITY PRODUCED IN 700 MWE STATIONS INCORPORATING THE STUDIED CCGT CYCLES AND COMBUSTOR/HEAT EXCHANGERS IS ESTIMATED AND COMPARED WITH THE COST OF ELECTRICITY IN CONVENTIONAL STEAM STATIONS.
DESCRIPTORS	CLOSED-CYCLE SYSTEMS;COAL;COMBINED-CYCLE POWER PLANTS: T1; COMBUSTION;COMBUSTORS;COMPARATIVE EVALUATIONS: Q1;COST;DESIGN: Q1;ELECTRIC POWER;GAS TURBINES;HEAT EXCHANGERS;MATERIALS; SILICON CARBIDES;STEAM TURBINES;THERMODYNAMIC CYCLES;WORKING FLUIDS

G-2

ACCESSION NO.	80X0083216
TITLE(MONO)	HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM. PHASE II. TECHNOLOGY TEST AND SUPPORT STUDIES. TECHNICAL PROGRESS REPORT, JANUARY 1, 1979-MARCH 31, 1979
CORPORATE AUTH	CURTISS-WRIGHT CORP., WOOD-RIDGE, NJ (USA). POWER SYSTEMS DIV.
SEC REPT NO	CW-WR—76-020-44A
PAGE NO	140
AVAILABILITY	NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-2291
DATE	APR 1979
CATEGORIES	EDB-200102;200104
PRIMARY CAT	EDB-200102
REPORT NO	FE—2291-44A
ABSTRACT	WORK PERFORMED ON THE HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM, PHASE II - TECHNOLOGY TEST AND SUPPORT STUDIES DURING THE PERIOD FROM 1 JANUARY 1979 THROUGH 31 MARCH 1979 IS SUMMARIZED. OBJECTIVES OF THE PROGRAM ELEMENTS AS WELL AS TECHNICAL PROGRESS AND PROBLEMS DURING THIS PHASE II QUARTERLY REPORTING PERIOD ARE PRESENTED. PLANNED PROGRESS DURING THE NEXT QUARTERLY REPORTING PERIOD IS ALSO DEFINED. PROGRESS ON DESIGN, FABRICATION AND CHECKOUT OF TEST FACILITIES AND TEST RIGS IS DESCRIBED. THE LP ENGINE TEST PROGRAM THROUGH 3000$SUP 0$F TURBINE INLET TEMPERATURE IS DISCUSSED. DESIGN AND ANALYSIS OF THE TSTR ENGINE AND SYNTHESIZED LOW BTU GAS COMPONENTS ARE DISCUSSED. SUPPORTING MATERIALS AND PROCESS INVESTIGATIONS ARE REVIEWED.
DESCRIPTORS	COATINGS;COMBINED-CYCLE POWER PLANTS: T1;COMBUSTORS;DESIGN; FABRICATION;GAS TURBINES: T2,Q1;LOW BTU GAS;PERFORMANCE; PERFORMANCE TESTING;RESEARCH PROGRAMS: Q2;TECHNOLOGY ASSESSMENT: Q2;TEST FACILITIES;VERY HIGH TEMPERATURE

G-3

ACCESSION NO.	80R0083215
TITLE(MONO)	HIGH-TEMPERATURE TURBINE TECHNOLOGY PROGRAM. OVERALL PLANT DESIGN DESCRIPTION (OPDD) COAL-DERIVED LIQUID ELECTRIC POWER PLANT
EDITOR OR COMP	HORNER, M.W.
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). GAS TURBINE DIV.
PAGE NO	192
AVAILABILITY	NTIS, PC A09/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-1806
DATE	MAR 1980
CATEGORIES	EDB-200102;010600
PRIMARY CAT	EDB-200102
REPORT NO	FE--1806-84
ABSTRACT	THIS REPORT DESCRIBES THE COAL-DERIVED LIQUID COMBINED CYCLE POWER SYSTEM CONCEPT DEVELOPED DURING PHASE II OF THE US DEPARTMENT OF ENERGY HIGH TEMPERATURE TURBINE TECHNOLOGY (DOE-HTTT) PROGRAM. THE REPORT DEFINES A HIGHLY RELIABLE, COMMERCIALLY VIABLE SYSTEM BASED ON COAL-DERIVED LIQUID (CDL) FUEL. THIS DEFINITION BUILDS ON THE PHASE I STUDY THROUGH ITS FOCUS ON A COAL-DERIVED LIQUID FUELED, HIGH FIRING TEMPERATURE, WATER-COOLED GAS TURBINE SYSTEM WITH A STEAM BOTTOMING PLANT THAT HAS ONE REHEAT STEAM TURBINE. THE CDL FUEL HANDLING LANT AND SUPPORT SYSTEM CONCEPTS ARE ALSO BASED ON APPROACHES INITIALLY DESCRIBED IN DOE-HTTT REPORT FE-1806-24, HIGH-TEMPERATURE TURBINE TECHNOLOGY PROGRAM, OVERALL PLANT DESIGN DESCRIPTION, COAL-DERIVED LIQUID ELECTRIC POWER PLANT. SIGNIFICANT CHANGES IN THE HARDWARE AND ITS FUNCTIONAL SEQUENCING ARE INCLUDED AND A MORE DETAILED EXPOSITION OF THE ORGANIZATION, OPERATION, AND CONTROL OF THE INTEGRATED SYSTEM IS PRESENTED. THE COMBINED-CYCLE SYSTEM SPECIFIED IN THIS REPORT PROVIDES IMPROVED FLEXIBILITY OF OPERATION AS WELL AS RELIABILITY AND EFFICIENCY. THE PRD-6 GAS TURBINE UTILIZED IN THE SYSTEM DESIGN HAS A 12:1 PRESSURE RATIO, COMPRESSOR INLET AIR FLOW OF 300 LB/SECOND, AND A 2600$SUP 0$F FIRING

	TEMPERATURE. THE PERFORMANCE CHARACTERISTICS OF THE OVERALL PLANT ARE GIVEN.
DESCRIPTORS	COAL GASIFICATION;COAL LIQUIDS: T2;COMBINED-CYCLE POWER PLANTS: T1;CONTROL SYSTEMS;DESIGN: 01;ENGINEERING;GAS TURBINES;LIQUID FUELS;LOW BTU GAS;SPECIFICATIONS: 02;STEAM TURBINES;THERMAL EFFICIENCY

G-4

ACCESSION NO.	80R0083214
TITLE(MONO)	HIGH-TEMPERTURE TURBINE TECHNOLOGY PROGRAM. OVERALL PLANT DESIGN DESCRIPTION (OPDD) LOW-BTU COAL GAS ELECTRIC POWER PLANT
EDITOR OR COMP	HORNER, M.W.
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). GAS TURBINE DIV.
PAGE NO	241
AVAILABILITY	NTIS, PC A11/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-1806
DATE	MAR 1980
CATEGORIES	EDB-200102;010404
PRIMARY CAT	EDB-200102
REPORT NO	FE--1806-83
ABSTRACT	THIS REPORT DESCRIBES THE LOW-BTU COAL GAS COMBINED CYCLE ELECTRIC POWER PLANT CONCEPT DEVELOPED DURING PHASE II OF THE US DEPARTMENT OF ENERGY HIGH TEMPERATURE TURBINE TECHNOLOGY (DOE-HTTT) PROGRAM. THE REPORT DEFINES A HIGHLY RELIABLE, COMMERCIALLY VIABLE SYSTEM BASED ON COAL-DERIVED FUEL. THIS DEFINITION BUILDS ON AND UPDATES THE PHASE I STUDY OF THE LOW-BTU COAL GASIFICATION COMBINED CYCLE SYSTEM. THE SYSTEM CONSISTS MAINLY OF HIGH-TEMPERATURE, WATER-COOLED GAS TURBINES THAT BURN COAL-DERIVED GAS FUEL, AND A STEAM BOTTOMING CYCLE WITH ONE REHEAT STEAM TURBINE. THE COAL GASIFIERS, LOW-BTU GAS CLEANUP, AND PLANT SUPPORT EQUIPMENT DEFINITIONS ARE ALSO BASED ON APPROACHES INITIALLY DESCRIBED IN DOE-HTTT REPORT FE-1806-23, HIGH-TEMPERATURE TURBINE TECHNOLOGY PROGRAM. OVERALL PLANT DESIGN DESCRIPTION, LOW-BTU COAL GAS ELECTRIC POWER PLANT. SIGNIFICANT CHANGES (FROM PHASE I) IN THE HARDWARE AND ITS FUNCTIONAL SEQUENCING ARE INCLUDED AND A MORE DETAILED DESCRIPTION OF THE ORGANIZATION, OPERATION, AND CONTROL OF THE INTEGRATED SYSTEM IS PRESENTED. THE MAIN CHANGES ARE THE ADDITION OF A RAW GAS STEAM GENERATOR (RGSG) AT THE GASIFIER EXIT AND THE USE OF THE SMALLER PHD-6 GAS TURBINES IN LIEU OF THE PHD-7 GAS TURBINES. THE COMBINED-CYCLE SYSTEM SPECIFIED IN THIS REPORT PROVIDES IMPROVED FLEXIBILITY OF OPERATION AS WELL AS RELIABILITY AND EFFICIENCY.
DESCRIPTORS	CALORIFIC VALUE;CHEMICAL COMPOSITION;COAL GASIFICATION; COMBINED-CYCLE POWER PLANTS: T1;CONTROL SYSTEMS;COST;DESIGN: 01; ELECTRIC POWER;ENGINEERING;EQUIPMENT;FLOWSHEETS;FUEL GAS;GAS TURBINES;LOW BTU GAS;PURIFICATION;STEAM TURBINES;THERMODYNAMIC CYCLES;WATER TREATMENT

G-5

ACCESSION NO.	80V0083205
TITLE	ASPECTS OF MEETING COMPLEX INDUSTRIAL ENERGY DEMAND PATTERNS USING RECUPERATED GAS TURBINES
AUTHORS	LOWDER, J.R.A.
AUTHOR AFF	GEC POWER ENGINEERING, WHETSTONE, ENGLAND
TITLE(MONO)	ENERGY FOR INDUSTRY
EDITOR OR COMP	O'CALLAGHAN, P.W. (ED.
PAGE NO	173-188
PUBL LOC	PERGAMON PRESS INC., ELMSFORD, NY
DATE	1979
CATEGORIES	EDB-200100;290800
PRIMARY CAT	EDB-200100
ABSTRACT	FOR MANY YEARS GAS TURBINES HAVE BEEN SUCCESSFULLY EMPLOYED IN COMBINED HEAT AND POWER (CHP) SCHEMES WHERE THE LOCAL ENERGY DEMAND PATTERN HAS BEEN SUITABLE. THE NORMAL PREREQUISITE FOR THIS HAS BEEN THE EXISTENCE OF A PROCESS HEAT REQUIREMENT SUCH THAT THE SITE HEAT TO POWER RATIO REMAINS REASONABLY CONSTANT THROUGHOUT THE YEAR. HOWEVER, MANY INDUSTRIAL SITES FALL INTO A SECOND CATEGORY CHARACTERISED BY THE ABSENCE OF A PROCESS HEAT DEMAND. THESE SITES CAN BE EXPECTED TO EXHIBIT LARGE DAILY AND SEASONAL VARIATIONS IN HEAT TO POWER RATIO AND WOULD NORMALLY BE CONSIDERED UNSUITABLE FOR GAS TURBINES AND PERHAPS ONLY MARGINALLY SUITABLE FOR DIESEL ENGINES. THESE PROBLEMS, AMONG MANY OTHERS, HAVE CONTRIBUTED TO THE RELATIVELY SLOW GROWTH OF INDUSTRIAL CHP OVER THE PAST TWO DECADES. HOW RECUPERATED GAS TURBINES, IN CONJUNCTION WITH APPROPRIATE CONTROL STRATEGIES, ARE ABLE TO ACCOMMODATE A WIDER VARIATION OF POWER DEMAND PATTERNS WITHOUT INVOLVING EXCESSIVE HEAT TOPPING OR DUMPING IS ILLUSTRATED. THREE DISTINCT CONFIGURATIONS OF CHP PLANT AND ASSOCIATED CONTROL ARE IDENTIFIED, WITH THE OPTIMUM DEPENDING ON DETAILS OF THE ANNUAL DISTRIBUTION OF HEAT AND POWER REQUIREMENT. A THERMODYNAMIC ANALYSIS OF THE PROPOSED SYSTEMS IS GIVEN AND SUPPORTED BY THE RESULTS OF A COMPUTER SIMULATION BASED ON THE MEASURED ENERGY PROFILE OF AN INDUSTRIAL SITE WHERE THE HEAT TO POWER RATIO WAS OBSERVED TO VARY FROM 0.5 TO 11.5 THROUGHOUT THE YEAR. ENERGY AND COST SAVINGS ARE PRESENTED FOR THE THREE CONFIGURATIONS AND A DISCUSSION ON THE PRACTICAL ENGINEERING ASPECTS IS ALSO INCLUDED. FINALLY, AREAS REQUIRING FURTHER RESEARCH ARE IDENTIFIED.
DESCRIPTORS	CO-GENERATION: T3;COMPUTERIZED SIMULATION;COST;ECONOMICS: 04; ENERGY CONSUMPTION;ENERGY DEMAND: T2;EVALUATION;GAS TURBINES: T4,03;HEAT EXCHANGERS;HEAT RECOVERY EQUIPMENT: 02;INDUSTRIAL PLANTS;INDUSTRY: T1;PERFORMANCE: 04;POWER DEMAND: 01; THERMODYNAMIC CYCLES

G-6

ACCESSION NO.	80C0082038
REPORT NO,PAGE	CONF-7906167 PP. 54-70
TITLE	DEVELOPMENT OF PRESSURIZED FLUIDIZED BED COMBUSTION FOR POWER GENERATION
AUTHORS	MOSKOWITZ, S.; ; LEON, A.; MOGUL, J.
AUTHOR AFF	CURTISS-WRIGHT CORP., WOOD-RIDGE, NJ
TITLE(MONO)	PRESSURIZED FLUIDIZED-BED COMBUSTION TECHNOLOGY EXCHANGE WORKSHOP
PAGE NO	54-70
AVAILABILITY	NTIS, PC A10/MF A01.
CONF TITLE	PRESSURIZED FLUIDIZED BED COMBUSTION TECHNOLOGY EXCHANGE

	WORKSHOP
CONF PLACE	SECAUCUS. NJ. USA
CONF DATE	5 JUN 1979
DATE	APR 1980
CATEGORIES	EDB-014000;200104
PRIMARY CAT	EDB-014000
REPORT NO	CONF-7906157--
ABSTRACT	THE PLAN FOR PFBC DEVELOPMENT WAS IMPLEMENTED IN SEVERAL WAYS. INITIALLY. LABORATORY RIGS WERE SET UP AND TESTS WERE CONDUCTED TO EVALUATE KEY AREAS UNDER SIMULATED CONDITIONS. WHILE THIS PROVIDED A TIMELY AND COST EFFECTIVE APPROACH FOR SCREENING OR PARAMETRIC STUDIES AND WHERE LONG TERM OPERATION WAS NOT THE OBJECTIVE. FURTHER DATA WAS NECESSARY UNDER CONDITIONS DUPLICATING A COAL-FIRED LARGE OR FULL SCALE PFB COMBUSTION SYSTEM. THEREFORE. A LARGE SCALE PFB TECHNOLOGY RIG WAS BUILT USING FULL SCALE BED INTERNAL HARDWARE TO PROVIDE FULL SCALE CIRCULATION AND COMBUSTION PATTERNS. FINALLY. A MEANS OF DETERMINING LONG TERM SERVICE OPERATION ON CANDIDATE MATERIALS OF CONSTRUCTION WAS NECESSARY FOR SELECTION OF THE ALLOYS AND/OR COATING SYSTEMS THAT WILL WITHSTAND THE COMMERCIALLY RELATED EXPOSURE TIMES. PERMISSION WAS OBTAINED FROM SEVERAL COMMERCIAL CLIENTS OPERATING DORR-OLIVER DESIGNED FLUIDIZED BED REACTORS TO INSTALL HEAT EXCHANGER TUBES IN THEIR UNITS FOR EXTENDED EXPOSURE PERIODS. THE TEST DATA FROM THIS STEPPING STONE APPROACH TOWARD PFBC DEVELOPMENT CAN BE APPLIED TO UTILITY DEMONSTRATION UNITS. INDUSTRIAL COGENERATION SYSTEMS. AND A VARIETY OF FBC APPLICATIONS FOR ENERGY INTENSIVE INDUSTRIES AND ULTIMATELY CAN BE USED TO EXPLOIT THE COMMERCIALIZATION POTENTIAL OF THE PFB TECHNOLOGY.
DESCRIPTORS	COAL: T1;COMBINED-CYCLE POWER PLANTS;COMMERCIALIZATION;DESIGN; FLUIDIZED-BED COMBUSTION: Q1;FLUIDIZED-BED COMBUSTORS: T2;GAS TURBINES;HEAT TRANSFER: Q2;MATERIALS TESTING: Q2;MEDIUM PRESSURE;NITROGEN OXIDES;PARTICLE SIZE;PILOT PLANTS;SULFUR DIOXIDE;TEST FACILITIES: Q2

G-7

ACCESSION NO.	80C0082036
REPORT NO.PAGE	CONF-7906157 PP. 15-47
TITLE	AEP/STAL-LAVAL PRESSURIZED FLUIDIZED BED COMBUSTION PROGRAM: REPORT ON PHASE II
AUTHORS	MARKOWSKY. J.J. ; O'CONNELL. L.P.; WICKSTROM. B.; JANSSON. S.A.
AUTHOR AFF	AMERICAN ELECTRIC POWER SERVICE CORP.. NEW YORK. NY
TITLE(MONO)	PRESSURIZED FLUIDIZED-BED COMBUSTION TECHNOLOGY EXCHANGE WORKSHOP
PAGE NO	15-47
AVAILABILITY	NTIS. PC A10/MF A01.
CONF TITLE	PRESSURIZED FLUIDIZED BED COMBUSTION TECHNOLOGY EXCHANGE WORKSHOP
CONF PLACE	SECAUCUS. NJ. USA
CONF DATE	5 JUN 1979
DATE	APR 1980
CATEGORIES	EDB-014000;200104
PRIMARY CAT	EDB-014000
REPORT NO	CONF-7906157--
ABSTRACT	THE AEP/STAL-LAVAL PROGRAM AND THE PHASE II ACTIVITIES ARE DESIGNED TO PROVIDE THE TECHNICAL AND ECONOMIC INFORMATION REQUIRED TO EVALUATE THE PRACTICALITY OF UTILIZING PFBC FOR ELECTRIC POWER GENERATION. THIS APPROACH IS THOUGHT TO BE BOTH PRUDENT AND EXPEDIENT IN ORDER TO COMMERCIALIZE PFBC IN A TIMELY FASHION. TODAY. UTILITIES MUST CONSIDER SEVERAL HIGHLY VARIABLE FACTORS WHILE PLANNING NEW GENERATION. THESE FACTORS INCLUDE ENVIRONMENTAL AND SITE RESTRICTIONS. HIGH COST OF CAPITAL. UNCERTAIN LOAD GROWTH PROJECTIONS AND CONTINUED ESCALATION OF POWER PLANT AND FUEL COSTS. THE PFBC TECHNOLOGY ADDRESSES THESE ISSUES IN THAT IT HAS PROVEN TO MEET OR EXCEED EPA'S PROPOSED NEW SOURCE PERFORMANCE STANDARDS. ITS CAPITAL COST AND CONSTRUCTION TIME IS LOWER IN COMPARISON WITH PROJECTED TO BE CURRENT TECHNOLOGIES. IN ADDITION. THE 500 MW PFBC PLANT ALLOWS A RAPID RESPONSE TO LOAD GROWTH REQUIREMENTS BECAUSE OF ITS SHORTER CONSTRUCTION TIME AND STANDARDIZED DESIGN. THE PFBC TECHNOLOGY WHILE ADDRESSING MANY OF THE VARIABLES THAT UTILITIES FACE TODAY. ALSO HAS GOOD POTENTIAL FOR CYCLE EFFICIENCY IMPROVEMENTS. THIS FEATURE WILL INCREASE THE ATTRACTIVENESS OF PFBC AS COAL PRICE CONTINUES TO ESCALATE.
DESCRIPTORS	COAL: T1;COMBINED-CYCLE POWER PLANTS: T3;COMMERCIALIZATION: Q2; CONTROL SYSTEMS: Q3;DESIGN;ENGINEERING;FEASIBILITY STUDIES; FLUIDIZED-BED COMBUSTION: T2,Q1;FLUIDIZED-BED COMBUSTORS;GAS TURBINES;MEDIUM PRESSURE;STEAM TURBINES;TEST FACILITIES: Q2

G-8

ACCESSION NO.	80X0076842
TITLE(MONO)	EROSION STUDY IN TURBOMACHINERY AFFECTED BY COAL AND ASH PARTICLES. ANNUAL PROGRESS REPORT. NOVEMBER 1. 1978-DECEMBER 31. 1979
EDITOR OR COMP	TABAKOFF. W.; HAMED. A.; RAMACHANDRAN. J.; KOTWAL. R.; BEACHER. B.
CORPORATE AUTH	CINCINNATI UNIV.. OH (USA). DEPT. OF AEROSPACE ENGINEERING AND APPLIED MECHANICS
PAGE NO	117
AVAILABILITY	NTIS. PC A06/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-2465
DATE	FEB 1980
CATEGORIES	EDB-200104;360105;010600
PRIMARY CAT	EDB-200104
REPORT NO	FE--2465-12
ABSTRACT	THREE ALLOYS WERE TESTED IN THE TEST FACILITY WHICH HAS BEEN DESIGNED TO SIMULATE THE AERODYNAMIC AND THERMODYNAMIC CONDITIONS IN THE TURBINE. THE EFFECTS ON EROSION DUE TO THE HIGH TEMPEATURE COAL ASH GAS STREAM WAS DETERMINED AT SEVERAL GAS TEMPERATURES. PARTICLE VELOCITIES AND ANGLES OF ATTACK. THE TEST RESULTS FOR 304 STAINLESS STEEL. RENE 41 AND A286. AND THE CORRESPONDING CONCLUSIONS ARE PRESENTED. IN ADDITION. A SERIES OF EXPERIMENTS WERE CONDUCTED TO DETERMINE THE EFFECTS OF FLY ASH CONSTITUENTS ON THE EROSION OF IRON AND NICKEL BASE ALLOYS. A NEW SEMI-EMPIRICAL EQUATION HAS BEEN OBTAINED FOR THE PREDICTION OF METAL EROSION DUE TO THE FLY ASH.
DESCRIPTORS	EQUATIONS;EROSION: T4,D,Q2,Q3;EXPERIMENTAL DATA: D;FLY ASH; FORECASTING;GAS TURBINES: T1,D;GRAPHS: D;MATERIALS: Q1; MATERIALS TESTING;MATHEMATICAL MODELS: Q4,D;RENE 41: T3,D; STAINLESS STEEL-304: T2,D;STAINLESS STEELS;TABLES: D; TEMPERATURE DEPENDENCE;TURBINE BLADES;VELOCITY

G-9

ACCESSION NO.	80J0065469
TITLE	165-MW COAL-FIRED PFB FOR OPERATION BY 1985
AUTHORS	FARMER, R.
PUB DESC	GAS TURBINE WORLD, V. 10, NO. 1, PP. 22-24, 26
DATE	MAR 1980
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
ABSTRACT	BY 1985, A 165-MW COMBINED CYCLE PLANT MODULE OPERATING ON HIGH SULFUR COAL BURIED IN A PRESSURIZED FLUIDIZED BED SYSTEM AND MEETING ALL PROPOSED EMISSION REGULATIONS WITHOUT STACK GAS SCRUBBERS COULD BE IN COMMERCIAL UTILITY OPERATION. A COMBINATION OF THREE OF THESE MODULES INTO A NOMINAL 500-MW CENTRAL STATION COULD GO OPERATIONAL SEVERAL YEARS AFTER THAT, OFFERING LOWER CAPITAL COSTS AND A BETTER HEAT RATE THAN PULVERIZED COAL STEAM PLANTS FOR BASE LOAD POWER GENERATION. THE PROGRAM BY CURTISS-WRIGHT POWER SYSTEMS TO MEET THE PROJECTED TIMETABLE IS DESCRIBED.
DESCRIPTORS	COAL;COMBINED-CYCLE POWER PLANTS: T2;COST;ENVIRONMENTAL EFFECTS;FLUIDIZED-BED COMBUSTION: Q1,Q2;FOSSIL-FUEL POWER PLANTS: T1,D;GAS TURBINES;GRAPHS: D;NUMERICAL DATA: D;OPERATION;PERFORMANCE: D;REGULATIONS;SCRUBBERS;SPECIFICATIONS: Q1,Q2,D;SULFUR;TABLES: D;TESTING

G-10

ACCESSION NO.	80R0065465
TITLE(MONO)	HIGH TEMPERATURE GAS TURBINE ENGINE COMPONENT MATERIALS TESTING PROGRAM: TASK I. FIRESIDE I. FINAL REPORT
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). GAS TURBINE DIV.
PAGE NO	286
AVAILABILITY	NTIS, PC A13/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-1765
DATE	1 JUL 1978
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
REPORT NO	FE--1765-44
ABSTRACT	THIS PROGRAM WAS DESIGNED TO EVALUATE THE EFFECT OF THE COMBUSTION PRODUCTS OF COAL-DERIVED FUELS ON CURRENT AND POTENTIAL MATERIALS USED IN GAS TURBINE HOT-SECTION COMPONENTS AND ON THE PLUGGING OF COOLING HOLES IN AIR-COOLED AIRFOILS. ATMOSPHERIC-PRESSURE SMALL BURNER RIGS AND TURBINE SIMULATORS, EACH OF WHICH CONSISTED OF A COMBUSTOR OPERATING AT ELEVATED PRESSURES AND DESIGN AIR FLOWS EQUIPPED WITH A SEGMENT OF A FIRST-STAGE NOZZLE, WERE USED IN THESE EVALUATIONS. ALKALI CONVERSION TESTS WERE CONDUCTED IN SMALL BURNER RIGS AND IN THE TURBINE SIMULATOR TO DETERMINE WHETHER ALKALI METALS IN MINERALS (SILICATES, ALUMINO-SILICATES, ETC.) CONVERT TO CORROSIVE WATER-SOLUBLE FORMS (SULFATES) DURING COMBUSTION. IT WAS FOUND THAT SUFFICIENT ALKALI IS RELEASED FROM THE SILICATE HOST TO PRODUCE AGGRESSIVE DEPOSITS OF NA$SUB 2$SO$SUB 4$ AND K$SUB 2$SO$SUB 4$, AND THAT MORE NA THAN K IS RELEASED. SCREENING TESTS WERE CONDUCTED IN SMALL BURNER RIGS TO DETERMINE THE CORROSIVE EFFECTS OF THE ALKALI CONTAMINANTS NA AND K EXPECTED IN COAL-DERIVED LIQUIDS. THE TWENTY-ONE MATERIALS TESTED IN ORDER OF DECREASING RESISTANCE TO HOT CORROSION AT 1600$SUP 0$F WERE CERAMICS, COATINGS AND CLADDINGS, AND CO- AND NI-BASE ALLOYS. POTASSIUM, IN COMBINATION WITH NA, IS MORE AGGRESSIVE THAN NA ALONE, AND CORROSION INCREASED WITH INCREASING POTASSIUM IN DEPOSITS. RELATIVE CORROSION RESISTANCE RANKING OF MATERIALS AGAINST NA ALONE, HOWEVER, IS THE SAME AS IN TESTS WITH NA AND K COMBINED. PARTS LIFE ESTIMATES WERE DETERMINED FOR REPRESENTATIVE NI- AND CO-BASE ALLOYS, THE CO-BASE COATINGS AND CLADDINGS, AND THE CLADDING FECRALY. THE ESTIMATES WERE FOR SEVERAL METAL PENETRATIONS, FUEL CONTAMINANT LEVELS OF 2 PPM NA AND 1 PPM K TO 10 PPM NA AND 20 PPM K, PRESSURES OF 5 ATM TO 15 ATM AND TEMPERATURES OF 1400 TO 1800$SUP 0$F.
DESCRIPTORS	COAL GASIFICATION;COBALT BASE ALLOYS;COMBINED-CYCLE POWER PLANTS;COMBUSTION PRODUCTS: T3,Q2;CORROSION PROTECTION: Q1;CORROSIVE EFFECTS: Q3;GAS TURBINES: T1;LOW BTU GAS: T2;MATERIALS TESTING;NICKEL BASE ALLOYS;PROTECTIVE COATINGS: Q1;RESEARCH PROGRAMS;SULFATES;VERY HIGH TEMPERATURE

G-11

ACCESSION NO.	80R0065464
TITLE(MONO)	STEAM INJECTED GAS TURBINE STUDY: AN ECONOMIC AND THERMODYNAMIC APPRAISAL. FINAL REPORT
EDITOR OR COMP	BROWN, D.H.

CORPORATE AUTH GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). CORPORATE RESEARCH AND DEVELOPMENT DEPT.
PAGE NO 62
AVAILABILITY DEP. NTIS, PC A04/MF A01.
DATE SEP 1979
CATEGORIES EDB-200104;296000
PRIMARY CAT EDB-200104
REPORT NO EPRI-NP--1186
ABSTRACT A STEAM-INJECTED GAS TURBINE WAS COMPARED TO THE SIMPLE CYCLE GAS TURBINE AND TO A COMBINED-CYCLE GAS TURBINE ON THE BASIS OF EFFICIENCY, SPECIFIC WORK, AND ECONOMICS IN PRODUCING ELECTRICITY. THE SELECTED OPERATING RATIO OF STEAM TO AIR-FLOW WAS APPROPRIATE FOR BOTH PEAK EFFICIENCY AND FOR LIMITATION OF A VISIBLE WHITE EXHAUST PLUME. MORE COMPLEX STEAM INJECTION GAS TURBINE CYCLES WERE NOT JUSTIFIED BY SUPERIOR ECONOMICS OR PERFORMANCE. THE ECONOMIC COMPARISONS SHOWED POTENTIAL ADVANTAGE FOR THE STEAM-INJECTED GAS TURBINE AT VIRTUALLY ALL ELECTRIC UTILITY CAPACITY FACTORS FOR USE AS COMPARED TO THE SIMPLE-CYCLE GAS TURBINE. THE STEAM-INJECTED GAS TURBINE SHOWS THE POSSIBILITY OF A COST OF ELECTRICITY COMPARABLE TO COMBINED CYCLES AT HIGHER CAPACITY FACTORS.
DESCRIPTORS COMBINED-CYCLE POWER PLANTS: T3,D;COMPARATIVE EVALUATIONS;COST: D;ECONOMIC ANALYSIS: Q1,Q3,D;EFFICIENCY: D;ELECTRIC POWER: D; GAS TURBINE POWER PLANTS;GAS TURBINES: T1,D;GRAPHS: D;NUMERICAL DATA: D;PERFORMANCE: Q1,Q3;POWER GENERATION;STEAM INJECTION: Q1; TABLES: D

G-12 ACCESSION NO. 80X0065463
TITLE(MONO) LONG-TERM MATERIALS TEST PROGRAM. QUARTERLY PROGRESS REPORT, OCTOBER-DECEMBER 1979
CORPORATE AUTH GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). ENERGY SYSTEMS PROGRAMS DEPT.
PAGE NO 11
AVAILABILITY NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT AC01-79ET15457
DATE JAN 1980
CATEGORIES EDB-200104;360105;014000
PRIMARY CAT EDB-200104
REPORT NO DOE/ET/15457--4
ABSTRACT MATERIALS ARE TO BE TESTED FOR PROTECTION OF GAS TURBINES FROM CORROSION CAUSED BY ALKALI IN THE EFFLUX FROM A PRESSURIZED FLUIDIZED-BED COMBUSTOR. THE TEST FACILITY AND TEST SECTIONS ARE DESCRIBED. (DLC)
DESCRIPTORS COAL;COMBUSTION PRODUCTS;CORROSION;FLUIDIZED-BED COMBUSTORS;GAS TURBINES: T1;MATERIALS TESTING: Q1;RESEARCH PROGRAMS;TEST FACILITIES

G-13 ACCESSION NO. 80X0065458
TITLE(MONO) LONG TERM MATERIALS TEST PROGRAM. QUARTERLY PROGRESS REPORT, JANUARY-MARCH 1980
CORPORATE AUTH GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). ENERGY SYSTEMS PROGRAMS DEPT.
PAGE NO 22
AVAILABILITY NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT AC01-79ET15457
DATE APR 1980
CATEGORIES EDB-200102
PRIMARY CAT EDB-200102
REPORT NO DOE/ET/15457--10
ABSTRACT OBJECTIVE OF THE PROGRAM IS TO IDENTIFY CORROSION-RESISTANT MATERIALS FOR POTENTIAL USE IN A GAS TURBINE. A TEST RIG HAS BEEN DEVISED FOR DETERMINING THE LONG-TERM EFFECTS OF COAL-FUELED PRESSURIZED FLUIDIZED-BED COMBUSTOR EXHAUST GAS ON SUCH MATERIALS. THE TEST IS DESCRIBED. (DLC)
DESCRIPTORS COAL;COMBINED-CYCLE POWER PLANTS: T1;CORROSION RESISTANT ALLOYS; EXHAUST GASES;FLUIDIZED-BED COMBUSTORS;GAS TURBINES: T2; MATERIALS TESTING: Q1,Q2;RESEARCH PROGRAMS;TEST FACILITIES

G-14 ACCESSION NO. 80J0061903
TITLE SUBSTITUTION OF CERAMICS FOR HIGH TEMPERATURE ALLOYS
AUTHORS PROBST, H.B.

AUTHOR AFF	NASA, CLEVELAND, OH
PUB DESC	AM. CERAM. SOC. BULL., V. 59, NO. 2, PP. 206-210
DATE	FEB 1980
CATEGORIES	EDB-360604;360205;360105;200104
PRIMARY CAT	EDB-360604
ABSTRACT	CERAMICS SUCH AS SILICON NITRIDE AND SILICON CARBIDE ARE CURRENTLY RECEIVING A GREAT DEAL OF ATTENTION AS POTENTIAL MATERIALS FOR ADVANCED GAS TURBINE ENGINES. THE PRIMARY ADVANTAGE OFFERED BY CERAMICS IS THEIR HIGH TEMPERATURE CAPABILITY, WHICH CAN RESULT IN TURBINE ENGINES OF IMPROVED EFFICIENCY. OTHER ADVANTAGES WHEN COMPARED WITH THE NICKEL AND COBALT ALLOYS IN CURRENT USE ARE RAW MATERIALS AVAILABILITY, LOWER WEIGHT, EROSION/CORROSION RESISTANCE, AND POTENTIALLY LOWER COST. THE USE OF CERAMICS IN THREE DIFFERENT SIZES OF GAS TURBINE ENGINES - LARGE UTILITY TURBINES, ADVANCED AIRCRAFT TURBINES, AND SMALL AUTOMOTIVE TURBINES - IS DISCUSSED. SPECIAL CONSIDERATIONS ARISING FROM THE SUBSTITUTION OF CERAMICS FOR HIGH TEMPERATURE ALLOYS, UNIQUE TO EACH OF THESE APPLICATIONS, ARE OUTLINED.
DESCRIPTORS	CERAMICS;COMPARATIVE EVALUATIONS: Q1,Q2,Q3;CORROSION RESISTANCE: Q1,Q2,Q3;COST;DENSITY;GAS TURBINES: T;METALS;NICKEL BASE ALLOYS: T3;SILICON CARBIDES: T2;SILICON NITRIDES: T1; SURFACE COATING: Q3

G-15

ACCESSION NO.	80X0061063
TITLE(MONO)	HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM. PHASE II. TECHNOLOGY TEST AND SUPPORT STUDIES. TECHNICAL PROGRESS REPORT, JULY 1, 1978-SEPTEMBER 30, 1978
CORPORATE AUTH	CURTISS-WRIGHT CORP., WOOD-RIDGE, NJ (USA). POWER SYSTEMS DIV.
SEC REPT NO	CW-WR--76-020-36A
PAGE NO	111
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-2291
DATE	OCT 1978
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
REPORT NO	FE--2291-36A
ABSTRACT	WORK PERFORMED ON THE HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM, PHASE II - TECHNOLOGY TEST AND SUPPORT STUDIES DURING THE PERIOD FROM JULY 1, 1978 THROUGH SEPTEMBER 30, 1978 IS SUMMARIZED. OBJECTIVES OF THE PROGRAM ELEMENTS AS WELL AS TECHNICAL PROGRESS AND PROBLEMS DURING THIS FOURTH PHASE II REPORTING PERIOD ARE PRESENTED. PLANNED PROGRESS DURING THE NEXT REPORTING PERIOD IS ALSO DEFINED. PROGRESS ON DESIGN, FABRICATION, AND CHECKOUT OF TEST FACILITIES AND TEST RIGS IS DESCRIBED. CASCADE TESTING OF TURBINE VANES WAS CONDUCTED IN A PARTICULATE-LADEN 3400$SUP 0$F (MAX.) GAS STREAM. ANALYTICAL PREDICTIONS OF LP ENGINE PERFORMANCE ARE DISCUSSED. PREPARATION AND EARLY TESTING OF SPECIMENS FOR MATERIALS TESTING IS REVIEWED.
DESCRIPTORS	COAL GASIFICATION;COMBINED-CYCLE POWER PLANTS: T1;COMBUSTION; DESIGN;FOSSIL-FUEL POWER PLANTS;GAS TURBINES: T2,Q1;LOW BTU GAS; MATHEMATICAL MODELS;PERFORMANCE TESTING;RELIABILITY;RESEARCH PROGRAMS: Q2;TEST FACILITIES

G-16

ACCESSION NO.	80C0056997
REPORT NO.PAGE	CONF-790749 PP. 887-912
TITLE	EROSION/CORROSION OF SMALL SUPERALLOY TURBINE ROTORS OPERATING IN THE EFFLUENT OF A PFB COAL COMBUSTOR
AUTHORS	ZELLARS, G.R.; BENFORD, S.M.; ROWE, A.P.; LOWELL, C.E.
AUTHOR AFF	LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	887-912
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-421000;200104;360105

PRIMARY CAT	EDB-421000
REPORT NO	CONF-790749--
ABSTRACT	INTEGRALLY CAST ALLOY 713LC AND IN792 + HF SUPERALLOY TURBINE ROTORS IN A SINGLE STAGE TURBINE WITH 6% PARTIAL ADMITTANCE HAVE BEEN OPERATED IN THE EFFLUENT OF A PRESSURIZED FLUIDIZED BED COAL COMBUSTOR FOR UP TO 164 HOURS. TOTAL MASS FLOW WAS 300 KG/HR AND AVERAGE PARTICULATE LOADINGS RANGED FROM 600 TO 2800 PPM FOR SEVERAL COAL/SORBENT COMBINATIONS. A 5.5 ATM TURBINE INLET GAS PRESSURE AND INLET GAS TEMPERATURES FROM 700 TO 800$SUP 0$C YIELDED ABSOLUTE GAS VELOCITIES AT THE STATOR EXIT OF ABOUT 500 M/S. THE ANGULAR ROTATION SPEED (40,000 RPM) OF THE 6-INCH DIAMETER ROTORS WAS EQUIVALENT TO A TIP SPEED OF ABOUT 300 M/S, AND AVERAGE GAS VELOCITIES RELATIVE TO THE ROTATING SURFACE RANGED FROM 260 TO 330 M/S AT MEAN RADIUS. THE ROTOR EROSION PATTERN REFLECTS HEAVY PARTICLE SEPARATION WITH SEVERE (5 TO 500 CM/YR) EROSION AT THE LEADING EDGE, PRESSURE SIDE CENTER, AND SUCTION SIDE TRAILING EDGE AT THE TIP. THE EROSION DISTRIBUTION PATTERN PROVIDES A SPECTRUM OF EROSION/OXIDATION/DEPOSITION AS A FUNCTION OF BLADE POSITION. THIS SPECTRUM INCLUDES ENHANCED OXIDATION (10 TO 100 X AIR), MIXED OXIDES IN EXPOSED DEPLETION ZONES, SULFUR RICH OXIDES IN DEPOSITION ZONES, AND RUGGED AREAS OF EROSIVE OXIDE REMOVAL. ALTHOUGH PARTICLE SEPARATION AND EROSIVE DAMAGE WILL BE MUCH LESS SEVERE IN LARGE TURBINES OPERATED AT LOWER PATICULATE LEVELS, THESE DATA SUGGEST THAT PREFERENTIAL DEGRADATION PATHS MAY EXIST EVEN UNDER THE TARGETED LOWER LOADINGS (<200 PPM) BECAUSE OF THE DIVERSITY OF POTENTIAL EROSION/CORROSION INTERACTIONS ALONG EROSION PATHS.
DESCRIPTORS	COAL;COMBUSTION PRODUCTS;CORROSION: Q1;DEPOSITION;EROSION: Q1; FLUIDIZED-BED COMBUSTION;FLUIDIZED-BED COMBUSTORS;GAS TURBINES: T1;IMPURITIES;MATERIALS: Q1;MEDIUM PRESSURE;OXIDATION;PARTICLES; TEST FACILITIES;TURBINE BLADES

G-17

ACCESSION NO.	80C0056564
REPORT NO.PAGE	CONF-790749 PP. 448-458
TITLE	MECHANICAL PROPERTY IMPROVEMENT OF PROTECTIVE COATINGS FOR TURBINE ENGINES USING COAL-DERIVED FUELS
AUTHORS	BEALE, H.A. ; WICKERSHAM, C.E.; FAIRBANKS, J.W.
AUTHOR AFF	BATTELLE COLUMBUS LABS., COLUMBUS, OH
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	448-458
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-360201;200104;360100;010405
PRIMARY CAT	EDB-360201
REPORT NO	CONF-790749--
ABSTRACT	MATERIAL SYSTEMS SUITABLE FOR STUDYING THE EFFECTS OF LOCAL STRAINS AROUND THE DISPERSED PHASER ON THE PEIERLS STRESS AND MECHANICAL PROPERTIES OF DISPERSION HARDENED COATINGS HAVE BEEN IDENTIFIED. NB-NB8$SUB 2$, NB-NBC, TI-TIB$SUB 2$, AND TI-TIC COATINGS ARE CURRENTLY BEING DEPOSITED BY DUAL SOURCE ELECTRON BEAM EVAPORATION. EXPERIMENTAL RESULTS FROM THESE INVESTIGATIONS WILL BE REPORTED AT A LATER DATE.
DESCRIPTORS	COAL LIQUIDS;COATINGS;DISPERSION HARDENING: Q1,Q2,Q3,Q4,Q5,Q6; ELECTRON BEAMS;EROSION;FABRICATION;FUEL SUBSTITUTION;GAS TURBINES: T7;MATERIALS;MECHANICAL PROPERTIES;NIOBIUM: T1; NIOBIUM BORIDES: T3;NIOBIUM CARBIDES: T4;PEIERLS-NABARRO FORCE; PROTECTIVE COATINGS: Q7;TITANIUM: T2;TITANIUM BORIDES: T6; TITANIUM CARBIDES: T5

G-18

ACCESSION NO.	80C0055380
REPORT NO.PAGE	CONF-790749 PP. 786-831
TITLE	EXECUTIVE SUMMARY OF THE OVERALL DEVELOPMENT PLAN FOR PHASES I, III, AND IV OF THE CERAMIC TECHNOLOGY READINESS PROGRAM
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES

EDITOR OR COMP FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO 766-831
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE CASTINE, ME, USA
CONF DATE 30 JUL 1979
DATE DEC 1979
CATEGORIES EDB-200104;360200
PRIMARY CAT EDB-200104
REPORT NO CONF-790749--
ABSTRACT TWO METHODS ARE BEING PURSUED TO ACHIEVE HIGHER TURBINE INLET TEMPERATURES. ONE RELATIVELY NEAR-TERM APPROACH INVOLVES THE USE OF ADVANCED COOLING TECHNIQUES WITH METALLIC NOZZLES AND BLADES. WHILE SOME PERFORMANCE PENALTY IS INCURRED DUE TO THE HIGHER COOLING REQUIREMENTS, THE NET EFFECT IS A SIZABLE PERFORMANCE IMPROVEMENT. THE OTHER APPROACH USES CERAMIC MATERIALS THAT REQUIRE LITTLE OR NO COOLING FOR AERODYNAMIC COMPONENTS, THUS ACHIEVING THE FULL BENEFIT OF THE HIGHER GAS TEMPERATURE. THE DEVELOPMENT REQUIREMENT IMPLICIT IN THIS DESIGN MEANS THAT THIS APPROACH WILL NOT BE AVAILABLE FOR SOME TIME. A CERAMIC TECHNOLOGY READINESS (CTR) PROGRAM, WAS THEREFORE, FORMULATED TO PROVIDE CONVINCING EVIDENCE THAT CERAMIC COMPONENTS CAN BE DEVELOPED THAT ARE VIABLE FOR THE OPERATIONAL REQUIREMENTS OF UTILITY SCALE GAS TURBINES OPERATED ON COAL-DERIVED FUELS. SUCH ENGINES CAN POTENTIALLY BENEFIT THE NATIONAL ENERGY SITUATION THROUGH: HIGHER EFFICIENCY, BETTER TOLERANCE OF OPERATING ENVIRONMENT, AND LOWER COST AND HIGHER AVAILABILITY. THUS, THE MAJOR OBJECTIVE FOR THE CTR PROGRAM IS TO DEVELOP CERAMIC FABRICATION AND DESIGN TECHNOLOGY THAT WILL YIELD LONG-LIFE, HOT SECTION COMPONENTS FOR ADVANCED UTILTY GAS TURBINES. THESE OBJECTIVES ARE MET WITH THE HIGH TEMPERATURE CERAMIC AUGMENTATION TURBINE (HICAT) CONCEPT WHICH IS DESCRIBED.
DESCRIPTORS CERAMICS;COOLING;DESIGN: Q1;GAS TURBINES: T1;MATERIALS: Q1; SILICON CARBIDES;SILICON NITRIDES;TEST FACILITIES;TURBINE BLADES

ACCESSION NO. 80C0055379
REPORT NO.PAGE CONF-790749 PP. 767-784
G-19 TITLE POTENTIAL OF RAPID SOLIDIFICATION RATE ALLOYS FOR GAS TURBINE ENGINES
AUTHORS COX, A.R. ; VAN REUTH, E.C.
AUTHOR AFF PRATT AND WHITNEY AIRCRAFT GROUP, WEST PALM BEACH, FL
TITLE(MONO) ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO 767-784
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE CASTINE, ME, USA
CONF DATE 30 JUL 1979
DATE DEC 1979
CATEGORIES EDB-200104;360100
PRIMARY CAT EDB-200104
REPORT NO CONF-790749--
ABSTRACT A DEVICE FOR PRODUCING RAPIDLY-SOLIDIFIED ALLOY POWDERS WAS CONSTRUCTED WHICH USES FORCED CONVECTIVE COOLING OF MOLTEN PARTICLES ACCELERATED FROM A CENTRAL SOURCE INTO A HIGH CONDUCTIVITY GAS QUENCH MEDIUM. MORE THAN 200 EXPERIMENTAL SUPERALLOY COMPOSITIONS HAVE BEEN ATOMIZED AND EVALUATED TO DATE. ALL FALL WITHIN THE GENERAL CLASS OF PRECIPITATION-HARDENING, NICKEL-BASE ALLOYS BUT CAN BE CATEGORIZED FURTHER ACCORDING TO THE FOLLOWING PARTICULARS: CONVENTIONAL PRECIPITATION-HARDENING SUPERALLOYS; ALLOYS NORMALLY REFERRED TO AS D.S. EUTECTIC, ALLOYS WITH HIGH $GAMMAS' CONCENTRATIONS (>60 A/O), OR ALLOYS BASED ON THE NI-AL-MO TERNARY. A SERIES OF POWDER CONSOLIDATION AND METALWORKING OPERATIONS WERE CARRIED OUT WITH THE RAPIDLY SOLIDIFIED POWDERS, WHICH INCLUDED HOT ISOSTATIC PRESSING EXTRUSION, ISOTHERMAL FORGING, AND COMBINATIONS THEREOF. BEST RESULTS WERE ACHIEVED WHEN THE PRIMARY METALWORKING OPERATION INCLUDED RELATIVELY LARGE DEFORMATIONS, ESPECIALLY WITH EXTRUSION. THE EXTENSION OF RAPID SOLIDIFICATION PROCESSING TO SUPERALLOY COMPOSITIONS ALLOWS ALLOY MODIFICATIONS TO BE MADE WHICH ARE CHARACTERISTICALLY OUTSIDE THE RANGE POSSIBLE BY CURRENT SUPERALLOY PROCESS METHODS. EUTECTIC REGIONS ARE ELIMINATED IN $GAMMAS-$GAMMAS' ALLOYS, SO THAT HIGHER ADDITIONS OF $GAMMAS' PARTITIONING ELEMENTS CAN BE ADDED. BCC MO OCCURRENCE IN THE NI-AL-MO-TYPE ALLOYS CAN BE CONTROLLED THROUGH HEAT TREATMENT TO PRODUCE EFFECTIVELY DISPERSED PHASES. INCIPIENT MELT TEMPERATURES ARE HIGH TO ENABLE EFFECTIVE HEAT TREAT, AND ADAPTABILITY OF THE POWDERS TO SUBSEQUENT FABRICATION IS ACHIEVED WITHIN REASONABLE ENGINEERING BOUNDARIES. HIGHER STRENGTH LEVELS THAN NOW ATTAINED, AS WELL AS BETTER SECOND ORDER PROPERTIES, SUCH AS HIGH MODULUS OF ELASTICITY AND OXIDATION RESISTANCE, RESULT BECAUSE OF THE ENHANCED ALLOYING CAPABILITY POSSIBLE WITH RAPID SOLIDIFICATION.
DESCRIPTORS ALLOYS;CORROSION RESISTANCE;GAS TURBINES: T1;MATERIALS: Q1; OXIDATION;POWDER METALLURGY: T;TURBINE BLADES

G-20

ACCESSION NO.	80C0055378
REPORT NO.PAGE	CONF-790749 PP. 715-766
TITLE	HIGH TEMPERATURE TECHNOLOGY PROGRAM FOR A WATER-COOLED GAS TURBINE
AUTHORS	CARUVANA, A.; SCHILLING, W.F.
AUTHOR AFF	GENERAL ELECTRIC CO., SCHENECTADY, NY
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	715-766
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;360103
PRIMARY CAT	EDB-200104
REPORT NO	CONF-790749--
ABSTRACT	THE HIGH TEMPERATURE TURBINE TECHNOLOGY (HTTT) DEVELOPMENT PROGRAMS HAVE DEMONSTRATED THE VIABILITY OF PRODUCING WATER-COOLED PARTS FOR A HIGH TEMPERATURE GAS TURBINE. ONLY A NUMBER OF THE TECHNOLOGY DEVELOPMENT PROGRAMS LEADING TO THE DEMONSTRATION OF TRV HAVE BEEN DESCRIBED IN THIS PAPER. REFERENCES ARE RECOMMENDED FOR FURTHER READING TO FULLY UNDERSTAND THE STRONG TECHNOLOGY BASE THAT HAS BEEN DEVELOPED TO SUPPORT THE DESIGN AND TEST OF A HIGH TEMPERATURE WATER-COOLED GAS TURBINE. THE AUTHORS BELIEVE THAT DEMONSTRATION OF WATER-COOLED GAS TURBINE TECHNOLOGY WILL PROVIDE AN ATTRACTIVE ALTERNATIVE TO SOME OF THE ENERGY PROBLEMS THE WORLD IS NOW EXPERIENCING. IT WILL PROVIDE FOR THE USE OF A GAS TURBINE IN A BASE-LOAD, COMBINED-CYCLE THAT FEATURES FUEL FLEXIBILITY, LOWER COST OF ELECTRICITY AND ONE THAT IS ENVIRONMENTALLY ACCEPTABLE.
DESCRIPTORS	CLADDING;COMBINED-CYCLE POWER PLANTS;COOLING: Q1;COPPER BASE ALLOYS: I2;GAS TURBINES: T1;INCONEL 617;INSPECTION;MATERIALS: Q1;MECHANICAL PROPERTIES: Q2;NONDESTRUCTIVE TESTING;NOZZLES; RESEARCH PROGRAMS: Q1;STRESS CORROSION;TEMPERATURE DEPENDENCE

G-21

99/5/0000033-0000114// 34

ACCESSION NO.	80C0055376
REPORT NO.PAGE	CONF-790749 PP. 680-703
TITLE	REVIEW OF NASA THERMA BARRIER COATING PROGRAMS FOR AIRCRAFT ENGINES
AUTHORS	GRISAFFE, S.J.; LEVINE, S.R.
AUTHOR AFF	LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	680-703
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;360200
PRIMARY CAT	EDB-200104
REPORT NO	CONF-790749--
ABSTRACT	INCREASES IN TURBINE INLET TEMPERATURES COUPLED WITH HIGH ENGINE PRESSURE RATIOS HAVE LED TO IMPROVED AIRCRAFT ENGINE PERFORMANCE. CURRENT GOALS ARE TO CONTINUE TO IMPROVE FUEL EFFICIENCY BY DECREASING THE USE OF COOLING AIR AS WELL AS TO IMPROVE ENGINE DURABILITY. THERMAL BARRIER COATINGS OFFER A POTENTIAL MEANS TO ACHIEVE BOTH GOALS. FOR THIS REASON NASA-LEWIS RESEARCH CENTER HAS BOTH AN IN-HOUSE AND A SUBSTANTIAL CONTRACTUAL EFFORT DIRECTED TOWARD ADVANCING THERMAL BARRIER COATING TECHNOLOGY. IN-HOUSE EFFORTS FOCUS ON COMPOSITIONAL OPTIMIZATION OF BOTH THE INSULATING CERAMIC OUTER LAYER AND THE METALLIC BOND COATING. ADVANCED COMPOSITIONS WITH TWICE THE LIFE OF THE EARLY NASA COATING HAVE BEEN IDENTIFIED. DEGRADATION MECHANISMS AND OXIDE PROPERTIES ARE BEING EXAMINED TO GUIDE COATING IMPROVEMENT. CONTRACTUALLY, ONE PROGRAM IS DEVELOPING COATINGS AS WELL AS COATING PROPERTY DATA SO AS TO

	PROVIDE A METHODOLOGY WHEREBY TBCS CAN BE DESIGNED IN AND TAILORED FOR SPECIFIC APPLICATIONS. FINALLY, A CONTRACTURAL EFFORT HAS DEMONSTRATED THE FEASIBILITY OF CLOSED-LOOP, COMPUTER-CONTROLLED, AUTOMATED PLASMA SPRAY COATING.
DESCRIPTORS	AIRCRAFT COMPONENTS;COOLING;EFFICIENCY: Q1;GAS TURBINES: T1; MATERIALS;PROTECTIVE COATINGS: T2,Q1;RESEARCH PROGRAMS: Q2; THERMAL SHIELDS

G-22

ACCESSION NO.	80C0055375
REPORT NO.PAGE	CONF-790749 PP. 667-679
TITLE	NASA PROGRESS ON CERAMIC COATINGS FOR INDUSTRIAL/UTILITY GAS TURBINES
AUTHORS	LEVINE, S.R.; HODGE, P.E.; MILLER, R.A.
AUTHOR AFF	LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	667-679
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;360200
PRIMARY CAT	EDB-200104
REPORT NO	CONF-790749--
ABSTRACT	CERAMIC COATINGS FOR INDUSTRIAL/UTILITY GAS TURBINES ARE BEING INVESTIGATED AT NASA LEWIS UNDER THE DOE SPONSORED CRITICAL RESEARCH AND ADVANCED TECHNOLOGY PROJECT. THE KEY VARIABLES CONTROLLING CERAMIC COATING LIFE IN CORROSIVE FUEL COMBUSTION PRODUCTS WERE DETERMINED IN BURNER RIG TESTS OF NA AND V HAVE BEEN DETERMINED. THERMOCHEMICAL CALCULATIONS OF CONDENSATE DEW POINTS AND MELTING POINTS COMBINED WITH THE TEMPERATURE PROFILE OF THE SPECIMENT WERE FOUND TO GIVE A GOOD EXPLANATION OF OBSERVED COATING FAILURE LOCATIONS. TO FURTHER ELUCIDATE POTENTIAL CERAMIC COATING FAILURE MECHANISMS, REACTION STUDIES BETWEEN COATING MATERIALS AND POTENTIAL IMPURITIES DERIVED FROM THE AIR, FUEL OR BOND COAT ARE BEING CARRIED OUT. ADVANCED COATINGS ARE ALSO BEING DEVELOPED. A CALCIUM SILICATE CERAMIC COATING AND A NICRALY/MGO CERMET COATING HAVE PERFORMED SUBSTANTIALLY BETTER THAN YTTRIA-STABILIZED ZIRCONIA COATINGS IN SODIUM PLUS VANADIUM CONTAMINATED FUEL. FINALLY, THE POTENTIAL BENEFITS OF THERMAL BARRIER COATINGS ON STEAM- AND WATER-COOLED GAS TURBINES IN A COMBINED CYCLE HAVE BEEN DETERMINED.
DESCRIPTORS	CERAMICS;CHEMICAL REACTIONS;CONDENSATES;CORROSION RESISTANCE; CORROSIVE EFFECTS;DEW POINT;GAS TURBINES: T1;MATERIALS; MATERIALS TESTING: Q2;MELTING POINTS;PROTECTIVE COATINGS: T2,Q1; SODIUM COMPOUNDS;TEMPERATURE DEPENDENCE;TEST FACILITIES;THERMAL SHIELDS;VANADIUM COMPOUNDS

G-23

ACCESSION NO.	80C0055371
REPORT NO.PAGE	CONF-790749 PP. 582-605
TITLE	CERAMIC COATING EVALUATIONS AND DEVELOPMENTS
AUTHORS	BRATTON, R.J.; LAU, S.K.; LEE, S.Y.; ANDERSSON, C.A.
AUTHOR AFF	WESTINGHOUSE RESEARCH AND DEVELOPMENT CENTR, PITTSBURGH, PA
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	582-605
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;360200
PRIMARY CAT	EDB-200104
REPORT NO	CONF-790749--
ABSTRACT	THIS PAPER SUMMARIZES PROGRESS ON A NASA/EPRI COATINGS PROGRAM THAT HAS THE OBJECTIVE TO EVALUATE THE RESISTANCE OF

	PRESENT-DAY THEMAL BARRIER COATINGS - ALL IN THE EARLY STAGES OF DEVELOPMENT - TO COMBUSTION GASES WHICH ARE FOUND IN ELECTRIC UTILITY TURBINES FIRED ON PETROLEUM FUELS OF VARYING IMPURITIES. THE SENSITIVITY OF THE COATINGS TO TEMPERATURE, FUEL IMPURITY, PRESSURE EFFECTS AND WATER WASHING WILL BE ESTABLISHED AS WELL AS COATING LIFETIME. THE COATINGS ARE PRIMARILY PLASMA-SPRAYED, ZIRCONIUM-BASED FORMULATIONS DEPOSITED ON SUPERALLOY TEST SPECIMENS THAT CAN BE AIR COOLED. BOTH DUPLEX COATING AND GRADED COATING SYSTEMS ARE BEING EVALUATED. TEST TEMPERATURES CURRENTLY RANGE FROM A GAS TEMPERATURE BEING EVALUATED. TEST TEMPERATURES CURRENTLY RANGE FROM A GAS TEMPERATURE OF 1900$SUP 0$F TO 2300$SUP 0$F AND FROM A SUBSTRATE METAL TEMPERATURE OF 1100$SUP 0$F TO 1650$SUP 0$F. FUEL IMPURITY SENSITIVITY STUDIES INCLUDE THE USE OF FUELS THAT RANGE FROM A CLEAN GT NO. 2 REFERENCE FUEL TO THAT DOPED WITH IMPURITY LEVELS WHICH SIMULATE BOTH WATER-WASHED AND UNTREATED RESIDUAL FUELS. THE CLEAN FUEL TEST RESULTS HAVE BEEN VERY ENCOURAGING IN THAT FAILURES WERE FEW. IN THE DIRTY FUEL TESTS, MIXED RESULTS WERE OBTAINED WITH GRADED COATINGS PERFORMING MUCH BETTER THAN DUPLEX COATINGS. THE RESULTS ARE DISCUSSED IN TERMS OF THE FINDINGS FROM PROTEST STUDIES. A NEW NASA/DOE PROGRAM HAS THE MAJOR OBJECTIVE TO DEVELOP ADVANCED CERAMIC COATINGS THAT WILL INCREASE INDUSTRIAL/UTILITY GAS TURBINE HOT SECTION DURABILITY WITH HEAVY EMPHASIS ON OPERATION WITH LOWER GRADE PETROLEUM FUELS AND LIQUID COAL-DERIVED FUELS.
DESCRIPTORS	ADHESION;CERAMICS;CHEMICAL COMPOSITION;CHEMICAL REACTIONS; COATINGS;COMBUSTION PRODUCTS;COMPARATIVE EVALUATIONS: Q2; CORROSION;CORROSION RESISTANCE;ELECTRON MICROPROBE ANALYSIS; FABRICATION;FUELS;GAS TURBINES: T1;MATERIALS: Q1;MATERIALS TESTING;METALLOGRAPHY;PHOSPHORUS;PROTECTIVE COATINGS: T2,Q1; RESEARCH PROGRAMS;RESIDUAL FUELS;TEST FACILITIES;THERMAL SHIELDS;VANADIUM;YTTRIUM OXIDES

G-24

ACCESSION NO.	80C0055370
REPORT NO.PAGE	CONF-790749 PP. 542-581
TITLE	THICK CERAMIC COATING DEVELOPMENT FOR INDUSTRIAL GAS TURBINES: A PROGRAM PLAN
AUTHORS	VOGAN, J.W.; STETSON, A.R.
AUTHOR AFF	SOLAR TURBINES INTERNATIONAL, SAN DIEGO, CA
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	542-581
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;360200
PRIMARY CAT	EDB-200104
AUGMENTATION	BLADE, BONDING LAYER, INTERMEDIATE CERAMIC
REPORT NO	CONF-790749--
ABSTRACT	NASA-LEWIS -FUNDED PROGRAM PLAN IS PRESENTED IN WHICH THE EFFECTIVENESS OF THICK CERAMIC COATINGS IN PREVENTING HOT CORROSION AND IN PROVIDING THERMAL INSULATION TO GAS TURBINE ENGINE COMPONENTS WILL BE INVESTIGATED. PRELIMINARY ANALYSIS OF THE BENEFIT OF THE THERMAL INSULATING EFFECT OF SUCH COATINGS ON DECREASING COOLING AIR AND SIMPLIFYING COMPONENT DESIGN APPEARS VERY ENCOURAGING. THE PROGRAM IS IN THE PRELIMINARY STAGES OF OBTAINING STARTING MATERIALS AND ESTABLISHING PROCEDURES.
DESCRIPTORS	ALUMINATES;CALCIUM COMPOUNDS;CERAMICS;CHEMICAL COMPOSITION; COATINGS;COMPARATIVE EVALUATIONS;CORROSION;FABRICATION;GAS TURBINES: T1;MAGNESIUM COMPOUNDS;MATERIALS;MATERIALS TESTING; PHYSICAL PROPERTIES;PLANNING;PROTECTIVE COATINGS: M2,Q1; RESEARCH PROGRAMS: Q2;SILICA;TEST FACILITIES;THERMAL EXPANSION; THERMAL SHIELDS;THERMAL SHOCK;TITANATES;TURBINE BLADES

G-25

ACCESSION NO.	80C0055369
REPORT NO.PAGE	CONF-790749 PP. 505-521
TITLE	SILICON AND CHROME BASE COATINGS FOR STATIONARY GAS TURBINES

AUTHORS	BAUER, R.; GRUENLING, H.W.; SCHNEIDER, K.
AUTHOR AFF	BROWN, BOVERI AND CIE, MANNHEIM, GERMANY
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	505-521
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;360105;360201
PRIMARY CAT	EDB-200104
REPORT NO	CONF-790749--
ABSTRACT	HOT CORROSION LIMITS THE LIFETIME OF STATIONARY GAS TURBINE BUCKETS. CHROMIUM AS WELL AS SILICON BASE COATING SYSTEMS HAVE BEEN DEVELOPED DUE TO THEIR ANTICIPATED ABILITY TO FORM OXIDE LAYERS WITH BETTER CHEMICAL RESISTIVITY AGAINST HIGH TEMPERATURE CORROSION ATTACK. THIS PAPER SUMMARIZES LABORATORY TEST RESULTS AND IN-SERVICE EXPERIENCE OF SUCH COATINGS APPLIED BY PACKCEMENTATION, GALVANIC PROCESSES AND PLASMA SPRAYING. AS AN EXAMPLE THE THERMOCHEMICAL DEGRADATION MECHANISM OF A CHROMIUM DIFFUSION COATING ON A FIRST STAGE VANE FROM A BLAST FURNACE GAS TURBINE WILL BE GIVEN. THE OBSERVED LIFETIME OF MORE THAN 35,000 HOURS IS MAINLY DUE TO THE OUTWARD DIFFUSION CHROMIUM FROM A CHROMIUM-RICH RESERVOIR LAYER THROUGH AN OVERLYING WORKING LAYER WITH A CONSTANT CHROMIUM CONTENT. COMPARABLE GOOD EXPERIENCE HAS BEEN HAD WITH GALVANIC CHROMIUM OVERLAY COATINGS WHERE $ALPHA$-CR IS ACTING LIKE A RESERVOIR LAYER. ON THE OTHER HAND SILICON-RICH PACKCEMENTATION COATINGS SHOWED SPALLING-OFF AS A CONSEQUENCE OF THE MORE BRITTLE NATURE OF THE SILICIDE PHASES. AT THE HIGHER MECHANICAL AND THERMAL STRESSES OF MODERN GAS TURBINES, MECHANICAL FAILURE BY CRACKING AND SPALLING LIMITS THE USE OF SUCH COATINGS WITH THEIR LAYER-LIKE STRUCTURE AND UNAVOIDABLE PHASE BOUNDARIES. FOR SUPERIOR PROPERTIES AT HIGHER TEMPERTURE, A NI-CR-SI PLASMA-COATING WITH A DUCTILE MATRIX AND DISPERSED RESERVOIR PARTICLES PROVIDES THE BEST COMPROMISE BETWEEN CORROSION RESISTANCE AND TOUGHNESS. A SERIES OF ENGINE RESULTS IS PRESENTED EMPHASIZING THE EFFECTIVENESS OF THIS COATING IN PROLONGING THE LIFETIME OF TURBINE BLADES AND VANES EVEN UNDER SEVERE ENVIRONMENTAL CONDITIONS.
DESCRIPTORS	BRITTLENESS;CHEMICAL COMPOSITION;CHROMIUM: T3;CHROMIUM COMPOUNDS;CHROMIUM SILICIDES: T4;COATINGS;CORROSION: Q1; FABRICATION: Q3,Q4,Q5;GAS TURBINES: T1;MATERIALS: Q1;NICKEL SILICIDES: T5;PROTECTIVE COATINGS: T2;SERVICE LIFE: Q2; SILICIDES;THERMAL STRESSES

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ACCESSION NO.	80C0055367
REPORT NO.PAGE	CONF-790749 PP. 473-488
TITLE	ADVANCED COATING DEVELOPMENT FOR INDUSTRIAL/UTILITY GAS TURBINE ENGINES
AUTHORS	GOEBEL, J.A.
AUTHOR AFF	PRATT AND WHITNEY AIRCRAFT, EAST HARTFORD, CT
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	473-488
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;360100
PRIMARY CAT	EDB-200104
REPORT NO	CONF-790749--
ABSTRACT	BASED ON THE RESULTS OF BURNER RIG HOT CORROSION TESTING, TWO EXPERIMENTAL COATING COMPOSITIONS HAVE BEEN SELECTED FOR COATING APPLICATION PROCESS EVALUATION AND ENGINE VERIFICATION TESTING. THE COMPOSITIONS SELECTED ARE GIVEN ALONG WITH THE CORRESPONDING EXPERIMENTAL ALLOYS TESTED. IT IS BELIEVED THAT

THE TWO EXPERIMENTAL COATING COMPOSITIONS WILL PROVIDE LOW TEMPERATURE CORROSION RESISTANCE SUPERIOR TO IN6250, WHILE STILL PROVIDING ADEQUATE HIGH TEMPERATURE RESISTANCE. ENGINE TEST PERFORMANCE OF THE EXPERIMENTAL COATINGS WILL BE COMPARED TO NEW IN6250 BASELINE COATINGS TO PROVIDE A BASIS FOR RELATING ENGINE TEST RESULTS TO BURNER RIG TEST RESULTS. EFFORTS INVOLVING THE STUDY OF ADVANCED COATING CONCEPTS HAVE BEEN INITIATED. A NUMBER OF EXPERIMENTAL ALLOYS HAVE BEEN PREPARED FOR OXIDATION AND HOT CORROSION STUDIES. ALLOY COMPOSITIONS SELECTED ARE EXPECTED TO FORM OXIDE SCALES DIFFERENT IN COMPOSITION FROM THOSE FORMED ON CURRENT MCRALY TYPE COATINGS. LABORATORY FURNACE TESTS WILL BE USED TO ASSESS THE RESISTANCE OF MODIFIED SCALES TO HOT CORROSION.

DESCRIPTORS: ALUMINIUM: T8;CHEMICAL REACTIONS: Q3,Q4;CHROMIUM ALLOYS: T5; COATINGS;COBALT ALLOYS: T2;COBALT OXIDES: T4;CORROSION RESISTANCE: Q2,Q5,Q6,Q7,Q8;DEPOSITS;GAS TURBINES: T1;MATERIALS: Q1;MIXTURES;MOLTEN SALTS;NICKEL ALLOYS: T7;OXIDES;PROTECTIVE COATINGS: Q1;SODIUM SULFATES;SULFATES;SULFUR TRIOXIDE: T3;TEST FACILITIES;TURBINE BLADES;YTTRIUM ALLOYS: T6

G-27

ACCESSION NO.	80C0055366
REPORT NO.PAGE	CONF-790749 PP. 416-447
TITLE	CORROSION EVALUATION OF SUPERALLOYS AND METAL COATINGS FOR COMBUSTION TURBINES UTILIZING ALTERNATE FUELS
AUTHORS	SPENGLER, C.J. ; LEE, S.Y.; SCHEIRER, S.T.
AUTHOR AFF	WESTINGHOUSE RESEARCH AND DEVELOPMENT CENTER, PITTSBURGH, PA
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	416-447
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;360105
PRIMARY CAT	EDB-200104
REPORT NO	CONF-790749--

ABSTRACT: THE OBJECTIVES OF THIS INVESTIGATION WERE TO: (1) EVALUATE ALLOYS AND COATINGS FOR USE WITH FUELS OTHER THAN CLEAN DISTILLATE OIL; (2) SELECT A TEST ENVIRONMENT THAT WOULD BE SIMULATIVE OF THE USE OF THE ALTERNATE FUEL IN A COMBUSTION TURBINE, AND (3) TO INVESTIGATE THE MECHANISMS OF CORROSION ATTACK WITH THE VARIOUS ALTERNATE FUELS, AND IF POSSIBLE, RELATE THE MECHANISMS TO ALLOY COMPOSITION AND COATING PROCESS VARIABLES. THE ALTERNATE FUELS INVESTIGATED CONSISTED OF SALT-CONTAMINATED SOUR NATURAL GAS, CRUDE AND HEAVY PETROLEUM OILS (WITH AND WITHOUT CHEMICAL ADDITIVES TO MITIGATE THE EFFECTS OF SODIUM AND VANADIUM), AND A SURROGATE FOR A COAL-DERIVED LIQUID FUEL. IT HAS BEEN DEMONSTRATED THAT THE POSSIBILITY OF ACCELERATED CORROSION ATTACK IN COMBUSTION TURBINES CAN BE ANSWERED WITH A COMBINATION OF APPROACHES SUCH AS A PROTECTIVE COATINGS AND ADDITIVES. THE SIMULATION OF ALTERNATE FUELS CAN BE ACCOMPLISHED WITH USE OF SURROGATE FUELS IN THE PRESSURIZED TEST PASSAGE. ONCE THE ENVIRONMENTAL EFFECT OF A PARTICULAR SIMULATED ALTERNATE FUEL IS ASCERTAINED THEN THE RESPONSE TO THE USE OF THE FUEL CAN BE DETERMINED, THAT IS, FUEL PRE-TREATMENT (WATER-WASHING, ADDITIVE ADDITIONS) USE OF MORE CORROSION RESISTANT SUPERALLOYS OR TYPES AND COMPOSITIONS OF PROTECTIVE COATINGS. IT WAS ESTABLISHED THAT THERE WAS A WIDE RESPONSE OF SUPERALLOYS AND COATINGS TO THE SIMULATED COMBUSTION ENVIRONMENTS. SOME HOT CORROSION RESISTANT COMPOSITIONS (COCRALY) DID NOT HAVE USEFUL LIFE IN VANADIUM-CONTAINING FUELS. THE MOST UNIVERSALLY USEFUL COMPOSITION AMONG THOSE TESTED APPEARS TO BE, ON THE BASIS OF THE VARIOUS EXPOSURES, THE PT-CONTAINING NIAL DIFFUSION COATING.

DESCRIPTORS: ADDITIVES;ALLOYS;ALUMINIUM ALLOYS: T7;CHEMICAL COMPOSITION: Q3,Q4,Q5,Q6,Q7;CHROMIUM ALLOYS: T3;COATINGS;COBALT ALLOYS; CORROSION;CORROSION RESISTANCE: Q3,Q4,Q5,Q6,Q7;FABRICATION: Q3,Q4,Q5,Q6,Q7;FUEL SUBSTITUTION: Q1;GAS TURBINES: T1; MATERIALS: Q1;MATERIALS TESTING: Q2;METALLOGRAPHY;NICKEL

ALLOYS: T6;PLATINUM ALLOYS: T5;PROTECTIVE COATINGS: T2;VANADIUM COMPOUNDS;YTTRIUM ALLOYS: T4

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ACCESSION NO.	80C0055364
REPORT NO,PAGE	CONF-790749 PP. 393-402
TITLE	ADVANCED GAS TURBINE COATINGS FOR MINIMALLY PROCESSED COAL DERIVED LIQUID FUELS
AUTHORS	BOONE, D.H. ; SHEN, S.S.; FAIRBANKS, J.W.
AUTHOR AFF	UNIV. OF CALIFORNIA, BERKELEY
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	393-402
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-200104;010405;360100;360200
PRIMARY CAT	EDB-200104
AUGMENTATION	GRADED CIATING COMPOSITIONS; MORE THAN ONE MATERIAL, ETC.
REPORT NO	CONF-790749--
ABSTRACT	FROM EXPERIENCE WITH GAS TURBINES BURNING CLEAN FUELS IN CLEAN ENVIRONMENTS AS WELL AS IN MARINE AND INDUSTRIAL ENVIRONEMENTS IT WAS FOUND THAT THE USE OF SOME TYPE OF PROTECTIVE COATING IS MANDATORY. A REVIEW OF THE RESEARCH AND DEVELOPMENT DIRECTIONS BEING PURSUED TO MEET THE SUBSTRATE MATERIAL REQUIREMENTS FINDS THAT THE PROCESSING TECHNIQUES AND ALLOYS ARE GETTING MORE COMPLICATED AND EXPENSIVE. A SIMILAR REVIEW OF THE DIRECTION AND PROGRESS IN THE DEVELOPMENT OF OXIDATION AND HOT CORROSION RESISTANT COATINGS INDICATES, IN GENERAL, A GREATER EMPHASIS ON THE IDENTIFICATION OF SUITABLY RESISTANT COMPOSITIONS WITH MUCH LESS ATTENTION BEING GIVEN TO STRUCTURAL EFFECTS. SUBSTRATE COMPATIBILITY AND METHODS OF ECONOMICAL AND RELIABLE APPLICATION. IT IS CLEAR THAT ADVANCED ENERGY CONVERSION SYSTEMS WILL REQUIRE THE COMBINATION OF A RELATIVELY COMPLEX SYSTEM OF SUBSTRATE ALLOY, COATING COMPOSITION, AND THEIR RELATIVE FABRICATION TECHNIQUES TO OBTAIN THE NECESSARY PERFORMANCE CHARACTERISTICS, EFFICIENCIES AND DURABILITIES. THE USE OF PROTECTIVE COATINGS, WITH A COMPOSITION TAILORED FOR A SPECIFIC ENVIRONMENT, APPLIED AS AN OVERLAY TO A SUBSTRATE ALLOY DESIGNED PRIMARILY FOR MECHANICAL PROPERTIES HAS BECOME THE BASIS FOR MANY ADVANCED GAS TURBINE ENGINES. ONE METHOD, THE ELECTRON BEAM-PHYSICAL VAPOR DEPOSITION PROCESS, EB-PVD, HAS BEEN IN PRODUCTION USE FOR TEN YEARS FOR GAS TURBINE AIRFOIL SYSTEMS AND HAS BEEN SHOWN TO BE AN ECONOMICALLY VIABLE MANUFACTURING TECHNIQUE. IN SPITE OF THIS SUCCESSFUL USE IN PRODUCTION, OR POSSIBLY BECAUSE OF IT, THE FULL CAPABILITIES OF THE EB-PVD PROCESS TO MEET THE NEW AND MORE DEMANDING REQUIREMENTS OF THE COATING DEVELOPER AND TURBINE DESIGNER HAVE BEEN INSUFFICIENTLY DOCUMENTED IN THE LITERATURE.
DESCRIPTORS	CERAMICS;COAL LIQUIDS;COATINGS: Q1;COMBUSTION PRODUCTS;ELECTRON BEAMS;FABRICATION: Q2;GAS TURBINES: T1;MATERIALS: Q2;MECHANICAL PROPERTIES;PROTECTIVE COATINGS: M2

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ACCESSION NO.	80C0055360
REPORT NO.PAGE	CONF-790749 PP. 287-300
TITLE	DESCRIPTION OF PROGRAM TO DEVELOP COMBUSTION TURBINE DESIGN GUIDELINES BASED ON DEPOSITION/CORROSION CONSIDERATIONS
AUTHORS	DECORSO, S.M.; VERMES, G.
AUTHOR AFF	WESTINGHOUSE ELECTRIC CORP., CONCORDVILLE, PA
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	287-300
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979

CATEGORIES EDB-200104;360105
PRIMARY CAT EDB-200104
REPORT NO CONF-790749--
ABSTRACT A TEST PROGRAM IS UNDERWAY WHICH WILL PROVIDE DEPOSITION/CORROSION GUIDELINES FOR THE DESIGN OF RELIABLE UTILITY TURBINES RUNNING ON LOW QUALITY FUELS AT HIGH CYCLE EFFICIENCIES. THE PROGRAM PHILOSOPHY IS BASED ON SIMILAR PROGRAMS WHICH PROVIDED SUCCESSFUL MACHINES FOR THE UTILITY INDUSTRY. SINCE DEPOSITION MIGHT BECOME MORE SIGNIFICANT THAN HITHERTO, THE TEST PROGRAM IS GEARED TOWARDS THE QUANTITATIVE ASSESSMENT OF DEPOSITION AS WELL AS CORROSION.
DESCRIPTORS ADDITIVES;COAL LIQUIDS;COOLING: Q1;CORROSION: Q1;DEPOSITION; DEPOSITS;DESIGN: Q1;EROSION;GAS TURBINES: T1;MATERIALS: Q1; OXIDATION;PARTICLES;RESIDUAL FUELS;SULFIDATION;TEMPERATURE DEPENDENCE;TURBINE BLADES;VANADIUM COMPOUNDS

99/5/0000033-0000114// 43
G-30 ACCESSION NO. 80R0055353
TITLE(MONO) EFFECT OF PRESSURE AND TURBINE INLET TEMPERATURE ON THE EFFICIENCY OF PRESSURIZED FLUIDIZED BED POWER PLANTS
EDITOR OR COMP GRAVES, R.L.
CORPORATE AUTH OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO 24
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT W-75-ENG-26
CONF TITLE 25. INTERNATIONAL GAS TURBINE CONFERENCE
CONF PLACE NEW ORLEANS, LA, USA
CONF DATE 9 MAR 1980
DATE 1979
CATEGORIES EDB-200102;200104;014000
PRIMARY CAT EDB-200102
REPORT NO CONF-800302--5
ABSTRACT THE DIFFICULTIES ENCOUNTERED IN PAST AND PRESENT EFFORTS TO OPERATE DIRECT COAL-FIRED GAS TURBINES ARE SUBSTANTIAL. HENCE THE DEVELOPMENT EFFORT REQUIRED TO ASSURE A RELIABLE, HIGH-TEMPERATURE PRESSURIZED FLUIDIZED BED (PFBC) COMBINED CYCLE MAY BE VERY EXPENSIVE AND TIME CONSUMING. IT IS THEREFORE IMPORTANT THAT THE BENEFIT OF ACHIEVING HIGH-TEMPERATURE OPERATION, WHICH IS PRIMARILY INCREASED EFFICIENCY, BE CLEARLY UNDERSTOOD AT THE OUTSET OF SUCH A DEVELOPMENT PROGRAM. THIS STUDY CHARACTERIZES THE EFFECTS OF PFBC TEMPERATURE AND PRESSURE ON PLANT EFFICIENCY OVER A WIDE RANGE OF VALUES. THERE IS AN APPROXIMATE THREE PERCENTAGE POINT ADVANTAGE BY OPERATING AT A GAS TURBINE INLET TEMPERATURE OF 870$SUP 0$ INSTEAD OF 538$SUP 0$C. OPTIMUM PRESSURE VARIES WITH THE GAS TURBINE INLET TEMPERATURE, BUT RANGES FROM 0.4 TO 1.0 MPA. AN ALTERNATE PFBC CYCLE OFFERING HIGH EFFICIENCY AT A PEAK TEMPERATURE OF ABOUT 650$SUP 0$C IS ALSO DISCUSSED.
DESCRIPTORS AIR POLLUTION CONTROL;COAL;COMBINED-CYCLE POWER PLANTS: T1,D; EFFICIENCY: Q1,D;FLUIDIZED-BED COMBUSTION;FLUIDIZED-BED COMBUSTORS: T3,Q1;GAS TURBINES: T2,Q1,D;GRAPHS: D;OPERATION: Q2,Q3;PERFORMANCE: Q2,Q3,D;PRESSURE DEPENDENCE;STEAM TURBINES; TEMPERATURE DEPENDENCE;THEORETICAL DATA: D
CONFIDENCE, AND COST. THE SPECIFIC PROPERTIES OF TENSILE STRESS AND ELASTIC MODULUS OF CERTAIN FIBER-REINFORCED EPOXY

G-31 ACCESSION NO. 80X0049157
TITLE(MONO) HTGR GAS TURBINE PROGRAM. SEMIANNUAL PROGRESS REPORT, APRIL 1-SEPTEMBER 30, 1978
CORPORATE AUTH GENERAL ATOMIC CO., SAN DIEGO, CA (USA)
PAGE NO 252
AVAILABILITY DEP. NTIS, PC A12/MF A01.
CONTRACT NO CONTRACT AT03-76SF70046
DATE DEC 1979
CATEGORIES EDB-210300
PRIMARY CAT EDB-210300
REPORT NO GA-A--15482
ABSTRACT THIS REPORT DESCRIBES WORK PERFORMED UNDER THE GAS TURBINE HTGR (HTGR-GT) PROGRAM, DEPARTMENT OF ENERGY CONTRACT DE-AT03-76-SF70046, DURING THE PERIOD APRIL 1, 1978 THROUGH SEPTEMBER 30, 1978. THE WORK REPORTED COVERS THE DEMONSTRATION AND COMMERCIAL PLANT CONCEPT STUDIES INCLUDING PLANT LAYOUT, HEAT EXCHANGER STUDIES, TURBOMACHINE STUDIES, SYSTEMS ANALYSIS, AND REACTOR CORE ENGINEERING.
DESCRIPTORS GAS TURBINES;HEAT EXCHANGERS;HTGR TYPE REACTORS: T1;PRIMARY COOLANT CIRCUITS;REACTOR CORES;REACTOR INTERNALS;RESEARCH PROGRAMS: Q1;SPECIFICATIONS

G-32 ACCESSION NO. 80R0054663
TITLE(MONO) WORLDWIDE SURVEY OF CURRENT EXPERIENCE BURNING RESIDUAL AND CRUDE OILS IN GAS TURBINES. FINAL REPORT
EDITOR OR COMP BUCKLAND, B.O.; KINDL, F.H.; LUKAS, H.
CORPORATE AUTH ENCOTECH, INC., SCHENECTADY, NY (USA)
PAGE NO 87
AVAILABILITY DEP. NTIS, PC A05/MF A01.
DATE DEC 1979
CATEGORIES EDB-025000;421000
PRIMARY CAT EDB-025000
REPORT NO EPRI-AF--1243
ABSTRACT THE PURPOSE OF THE PROJECT WAS TO SURVEY OWNERS OF GAS TURBINES BURNING RESIDUAL FUEL TO IDENTIFY OPERATING PROBLEMS, COSTS, AND GENERAL OWNERS' REACTION TO BURNING RESIDUAL FUEL. OWNERS WERE CONTACTED BY MAIL AND PERSONAL VISITS AND THE RESULTS ARE SUMMARIZED IN THIS REPORT. THE GENERAL CONCLUSION IS THAT RESIDUAL OIL IS A PRACTICAL FUEL FOR GAS TURBINES. CAPITAL AND OPERATING COSTS WILL BE HIGHER AND EXTRA ATTENTION TO SYSTEM DESIGN IS REQUIRED AS COMPARED WITH DISTILLATE OPERATION. WHEN THE COST DIFFERENTIAL BETWEEN DISTILLATE AND RESIDUAL (OR CRUDE) FUEL JUSTIFIES IT, RESIDUAL IS A PRACTICAL ALTERNATIVE.
DESCRIPTORS FUEL SUBSTITUTION: Q1,Q2,Q3;GAS TURBINES: T1;OPERATION; PERFORMANCE;PETROLEUM: T3;PETROLEUM RESIDUES;RESIDUAL FUELS: T2

G-33 99/5/0000033-0000114// 46

ACCESSION NO. 80H0054437
TITLE(MONO) ADVANCED COAL-FUELED COMBUSTOR/HEAT EXCHANGER TECHNOLOGY STUDY
EDITOR OR COMP CAMPBELL, J.C. JR.
CORPORATE AUTH ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA (USA). ROCKETDYNE DIV.
PAGE NO 266
AVAILABILITY DEP. NTIS, PC A12/MF A01.
CONTRACT NO CONTRACT EF-77-C-01-2612
DATE JUN 1978
CATEGORIES EDB-014000;421000;360103
PRIMARY CAT EDB-014000
REPORT NO FE--2612-13
ABSTRACT MUCH OF THE RATIONALE FOR STUDYING THE COAL-FIRED, CLOSED-CYCLE, GAS TURBINE, POWER GENERATION SYSTEM LIES IN TWO FACTORS. THE CLOSED-CYCLE GAS TURBINE POWER SYSTEM, WHICH UTILIZES A NON-CONDENSING WORKING FLUID, IS CAPABLE OF HIGHER OVERALL THERMAL EFFICIENCIES THAN IS THE CONVENTIONAL STEAM BASED RANKINE SYSTEM UTILIZED IN PRESENT DAY STEAM POWER STATIONS. IT UTILIZES HIGHER WORKING FLUID TEMPERATURES TO ACHIEVE THIS HIGHER EFFICIENCY. ADDITIONALLY, THE UTILIZATION OF THE CLOSED-CYCLE AS OPPOSED TO THE OPEN GAS TURBINE CYCLE, ISOLATES THE TURBOMACHINERY FROM THE PRODUCTS OF COAL COMBUSTION. THESE COAL COMBUSTION PRODUCTS ARE SO DIRTY, CORROSIVE, AND EROSIVE THAT NO PRACTICAL SYSTEM FOR THEIR DIRECT UTILIZATION IN GAS TURBINES HAS YET BEEN DEVISED, AND NEAR TERM ACHIEVEMENT OF PRACTICAL COAL-FIRED, OPEN-CYCLE GAS TURBINES APPEARS UNLIKELY. THE DIRECT COAL FIRING OF HEAT EXCHANGERS, BY COMPARISON, IS PRESENT DAY STATE-OF-THE-ART AT THE LOWER WORKING FLUID TEMPERATURES TYPICAL OF TODAY'S STEAM BASED POWER CYCLES. THE OPERATING REQUIREMENTS FOR THE COAL-FIRED COMBUSTOR/HEAT EXCHANGER OF A CLOSED-CYCLE GAS TURBINE POWER CONVERSION SYSTEM DIFFER FROM THOSE OF STEAM BOILERS IN SEVERAL RESPECTS, PARTICULARLY AS REGARDS MAXIMUM HEATING SURFACE TEMPERATURES, BUT THEY ARE SUFFICIENTLY SIMILAR THAT THE ATTAINMENT OF TECHNOLOGY READINESS FOR SUCH COMBUSTOR/HEAT EXCHANGERS IS EXPECTED TO BE ATTAINABLED FOR MODEST DEVELOPMENT COSTS AND IN THE NEAR FUTURE, THUS PERMITTING MORE EFFICIENT UTILIZATION OF THE ONLY ECONOMICALLY ABUNDANT US FUEL, COAL. THE EFFORT CONTRACTED UNDER EF-77--01-2612 CONSISTED ENTIRELY OF STUDIES, ANALYSES, DESIGN EFFORT AND REPORTING. NO FABRICATION OR TEST EFFORT WAS INVOLVED.
DESCRIPTORS ALLOY-HK-40;BOTTOMING CYCLES;CERAMICS;CHROMIUM-MOLYBDENUM STEELS;CLOSED-CYCLE SYSTEMS: Q3;COAL;COMBUSTION;COMBUSTORS: T1; CORROSION;CREEP;DESIGN: Q1,Q2;FEASIBILITY STUDIES;FLUIDIZED-BED COMBUSTION;GAS TURBINES: T3;GRAPHS: D;HASTELLOY X;HAYNES 188 ALLOY;HEAT EXCHANGERS: T2;HEAT TRANSFER;INCOLOY 800;INCONEL 617; MATERIALS: T4,D,Q1,Q2;MECHANICAL PROPERTIES: Q4,D;NUMERICAL DATA: D;PRICES;STAINLESS STEEL-304;STAINLESS STEEL-316; STAINLESS STEEL-347;TABLES: D;TEMPERATURE DEPENDENCE; THERMODYNAMIC CYCLES;WORKING FLUIDS: Q3

G-34 99/5/0000033-0000114// 47

ACCESSION NO. 80C0053967
REPORT NO.PAGE CONF-790749 PP. 28-44
TITLE ALTERNATE FUELS IN DIRECTLY FIRED HEAT ENGINES
AUTHORS THOMAS, H.L.; CONTA, L.D.
TITLE(MONO) ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO 28-44
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE CASTINE, ME, USA
CONF DATE 30 JUL 1979
DATE DEC 1979
CATEGORIES EDB-010405;040403;010600;040500
PRIMARY CAT EDB-010405
REPORT NO CONF-790749--
ABSTRACT RESEARCH IMPLICATIONS OF FUTURE ALTERNATIVES FOR COMBUSTION ENGINE, BASE LOAD APPLICATIONS FOCUS ON THE NEED TO ASSURE COMPONENT RELIABILITY AND LOW MAINTENANCE COSTS WHILE IMPROVING OVERALL EFFICIENCY TO OFFSET INCREASED COSTS INHERENT IN THE COMPLEXITY OF PRODUCING AND DISTRIBUTING ALTERNATE FUELS. BASED ON PROJECTED FUEL COSTS, LOW-BTU GAS, SHALE LIQUIDS, SYNTHETIC NATURAL GAS AND RAW COAL LIQUID DISTILLATES APPEAR TO BE LEADING NEAR TERM CONTENDERS FOR BASE- LOAD TURBINE, DIESEL, AND GAS ENGINE APPLICATIONS AS SOURCES OF PETROLEUM-BASED ENGINE FUELS DIMINSH. RESEARCH DIRECTED AT MAKING THESE FUELS AVAILABLE IN SUFFICIENT QUANTITY AND QUALITY TO PERMIT THEIR USE IN AN EFFICIENT AND ENVIRONMENTALLY ACCEPTABLE MANNER IS VITALLY NEEDED. RESEARCH EFFORTS TO DATE HAVE IDENTIFIED SEVERAL KEY AREAS TO BE RESOLVED FOR EACH OF THESE FUELS; THESE ARE DESCRIBED IN THE PAPER. SHALE OIL APPEARS TO BE THE MOST REASONABLE CHOICE FOR EARLY APPLICATION, BUT THE PROBLEMS ASSOCIATED WITH LARGE SCALE PRODUCTION OF SHALE MAKE THE EARLY DEVELOPMENT OF COAL-DERIVED LIQUIDS AND GASES OF VITAL IMPORTANCE. WITH RESPECT TO ENGINE DEVELOPMENT, HIGH TEMPERATURE MATERIALS AND PROTECTIVE COATINGS WILL UNDOUBTEDLY PLAY A MAJOR ROLE IN PERMITTING ENGINES AND TURBINES BOTH TO DEVELOP HIGHER EFFICIENCIES AND TO SURVIVE IN THE MORE HOSTILE ATMOSPHERE ASSOCIATED WITH LESS REFINED AND ALTERNATE FUELS. INTEGRATED GASIFIER-TURBINE, COMBINED-CYCLE PLANTS APPEAR ECONOMICALLY ATTRACTIVE COMPARED TO OTHER ALTERNATIVE FUEL OPTIONS FOR THE GAS TURBINE. SINCE THE COMPONENTS HAVE ALREADY BEEN PROVEN INDIVIDUALLY, EARLY APPLICATION OF THIS TECHNOLOGY SHOULD BE PLANNED, WITH RESEARCH AND DEVELOPMENT EMPHASIS ON COMBUSTOR DEVELOPMENT, LOAD-FOLLOWING CHARACTERISTICS, AND GAS PURIFICATION. (LTN)
DESCRIPTORS ANTIKNOCK RATINGS;COAL LIQUEFACTION;COAL LIQUIDS: T2; COMPARATIVE EVALUATIONS: Q2,Q3;DIESEL ENGINES;ECONOMICS;FUEL SUBSTITUTION: Q1;GAS TURBINES;HYDROGENATION;INTERNAL COMBUSTION ENGINES: T1;MAINTENANCE: Q1;METHANOL;RECOMMENDATIONS;REFINING;

Q2;RESEARCH PROGRAMS: Q1,Q2,Q3;SHALE OIL: T3;SOOT

G-35

ACCESSION NO.	80C0053834
REPORT NO.PAGE	CONF-790749 PP. 18-27
TITLE	ADVANCED FOSSIL POWER SYSTEMS DEPARTMENT CLEAN FUEL PROGRAM
AUTHORS	ALPERT, S.B.; ROVESTI, W.
AUTHOR AFF	ELECTRIC POWER RESEARCH INST., PALO ALTO, CA
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
PAGE NO	18-27
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-010404;010405
PRIMARY CAT	EDB-010404
AUGMENTATION	EPRI
REPORT NO	CONF-790749--
ABSTRACT	THE OBJECTIVE OF THE EPRI PROGRAM IS TO PRODUCE FUELS FROM A VARIETY OF US COALS THAT ARE USEFUL FOR A MIX OF POWER GENERATING SYSTEMS, THAT ARE ECONOMICALLY COMPETITIVE AND THAT SATISFY PROJECTED ENVIRONMENTAL STANDARDS. IN CONJUNCTION WITH THE R AND D PROGRAM COMPREHENSIVE ENGINEERING AND ECONOMIC EVALUATIONS ARE CARRIED OUT TO ASSESS THE RELATIVE ATTRACTIVENESS NEW PROCESSES FOR APPLICATION BY THE POWER INDUSTRY FOR NEW AND RETROFIT APPLICATIONS. THE EPRI STUDIES INDICATE THAT: (1) INTEGRATED GASIFICATION COMBINED CYCLE PLAN USING OFF THE SHELF COMBUSTION TURBINES ARE ECONOMICALLY COMPETITIVE WITH PULVERIZED FUEL PLANTS THAT USE FLUE GAS DESULFURIZATION, AND (2) WITH MORE STRINGENT AIR, WATER, AND SOLID WASTE STANDARDS IGCC PLANTS APPEAR EVEN MORE ATTRACTIVE. THE CLEAN LIQUID AND SOLID FUEL PROGRAMS SUPPORT R AND D IN DIRECT AND INDIRECT TECHNIQUES TO BRING A NUMBER OF TECHNOLOGIES TO A STATUS OF TECHNICAL READINESS THAT WILL PERMIT COMMERCIAL PLANTS TO BE RELIABLY DESIGNED BY THE MID TO LATE 1980'S. THE PROGRAMS INVOLVE A WIDE VARIETY OF FUELS MEETING UTILITY SPECIFICATIONS AND WILL BE ABLE TO UTILIZE A LARGE VARIETY OF US COALS. MAJOR PROJECTS BEING SUPPORTED ARE LISTED. AN ASSOCIATED R AND D PROGRAM HAS AS ITS OBJECTIVES: (1) MORE RELIABLE COMBUSTION TURBINE EQUIPMENT FOR GENERATING ELECTRICITY, AND (2) ADAPTING COMBUSTION TURBINE EQUIPMENT TO UTILIZE SYNTHETIC FUELS.
DESCRIPTORS	CE ENTRAINED FUEL PROCESS;COAL GASIFICATION: M1;COAL LIQUEFACTION: M2;COMBINED-CYCLE POWER PLANTS;DEMONSTRATION PLANTS;EPRI;EXXON LIQUEFACTION PROCESS;GAS TURBINES;H-COAL PROCESS;INTERMEDIATE BTU GAS;LOW BTU GAS;METHANOL;PILOT PLANTS; RESEARCH PROGRAMS: Q1,Q2;SRC PROCESS;SRC-II PROCESS;TEXACO GASIFICATION PROCESS

G-36

ACCESSION NO.	80C0053833
TITLE(MONO)	ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP	FAIRBANKS, J.W.; STRINGER, J. (EDS.
CORPORATE AUTH	DEPARTMENT OF ENERGY, WASHINGTON, DC (USA). ASSISTANT SECRETARY FOR FOSSIL ENERGY; ELECTRIC POWER RESEARCH INST., PALO ALTO, CA (USA). FOSSIL FUEL AND ADVANCED SYSTEMS DIV.
PAGE NO	976
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE	CASTINE, ME, USA
CONF DATE	30 JUL 1979
DATE	DEC 1979
CATEGORIES	EDB-010404;010405;360100;360200;421000;200104;014000
PRIMARY CAT	EDB-010404
REPORT NO	CONF-790749--
ABSTRACT	THE FIRST CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES WAS HELD AT THE MAINE

DEPARTMENT OF ENERGY. (ASSISTANT SECRETARY FOR FOSSIL ENERGY) AND THE ELECTRIC POWER RESEARCH INSTITUTE. (DIVISION OF FOSSIL FUEL AND ADVANCED SYSTEMS). FORTY-FOUR PAPERS FROM THE PROCEEDINGS HAVE BEEN ENTERED INTO EDB AND ERA AND ONE ALSO INTO EAPA; THREE HAD BEEN ENTERED PREVIOUSLY FROM OTHER SOURCES. THE PAPERS ARE CONCERNED WITH US DOE RESEARCH PROGRAMS IN THIS AREA. COAL GASIFICATION. COAL LIQUEFACTION. GAS TURBINES. FLUIDIZED-BED COMBUSTION AND THE MATERIALS USED IN THESE PROCESSES OR EQUIPMENTS. THE MATERIALS PAPERS INVOLVE ALLOYS. CERAMICS. COATINGS. CLADDING. ETC.. AND THE FABRICATION AND MATERIALS LISTING OF SUCH MATERIALS AND STUDIES INVOLVING CORROSION. EROSION. DEPOSITION. ETC. (LTN)

DESCRIPTORS	ALLOYS;CERAMICS;CLADDING;COAL GASIFICATION: T1;COAL LIQUEFACTION: T2;COATINGS: T6;CORROSION;DIESEL ENGINES: T5; EROSION;FLUIDIZED-BED COMBUSTION: T4;FUEL SUBSTITUTION;GAS TURBINES: T3;HOT GAS CLEANUP;LEADING ABSTRACT;MATERIALS: Q1,Q2,Q3,Q4,Q5;MATERIALS TESTING;MECHANICAL PROPERTIES; MEETINGS: Q6,Q7;PROTECTIVE COATINGS: T7;RESEARCH PROGRAMS;US DOE

G-37

ACCESSION NO.	80X0049692
TITLE(MONO)	ADVANCED GAS-COOLED NUCLEAR REACTOR MATERIALS EVALUATION AND DEVELOPMENT PROGRAM. PROGRESS REPORT, JULY 1, 1979-SEPTEMBER 30, 1979
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). ENERGY SYSTEMS PROGRAMS DEPT.
PAGE NO	52
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2975
DATE	7 MAR 1980
CATEGORIES	EDB-360103;360105;210300;360102
PRIMARY CAT	EDB-360103
REPORT NO	COO--2975-37
ABSTRACT	THE RESULTS OF WORK PERFORMED FROM JULY 1, 1979 THROUGH SEPTEMBER 30, 1979 ON THE ADVANCED GAS-COOLED NUCLEAR REACTOR MATERIALS EVALUATION AND DEVELOPMENT PROGRAM ARE PRESENTED. THE OBJECTIVES OF THIS PROGRAM ARE TO EVALUATE CANDIDATE ALLOYS FOR VERY HIGH TEMPERATURE REACTOR (VHTR) NUCLEAR PROCESS HEAT (NPH) AND DIRECT CYCLE HELIUM TURBINE (DCHT) APPLICATIONS, IN TERMS OF THE EFFECT OF SIMULATED REACTOR PRIMARY COOLANT (HELIUM CONTAINING SMALL AMOUNTS OF VARIOUS OTHER GASES), HIGH TEMPERATURES, AND LONG TIME EXPOSURES, ON THE MECHANICAL PROPERTIES AND STRUCTURAL AND SURFACE STABILITY OF SELECTED CANDIDATE ALLOYS. A SECOND OBJECTIVE IS TO SELECT AND RECOMMEND MATERIALS FOR FUTURE TEST FACILITIES AND MORE EXTENSIVE QUALIFICATION PROGRAMS. WORK COVERED IN THIS REPORT INCLUDES THE ACTIVITIES ASSOCIATED WITH THE STATUS OF THE SIMULATED REACTOR HELIUM SUPPLY SYSTEM, TESTING EQUIPMENT, AND GAS CHEMISTRY ANALYSIS INSTRUMENTATION AND EQUIPMENT. THE STATUS OF THE DATA MANAGEMENT SYSTEM IS PRESENTED. IN ADDITION, THE PROGRESS IN THE SCREENING TEST PROGRAM IS DESCRIBED.
DESCRIPTORS	ALLOY-MO-556: T6;ALLOY-IN-738: T11;ALLOY-MO-RE-2: T9;ALUMINIUM OXIDES: T5;CONTROLLED ATMOSPHERES;CORROSION RESISTANCE: Q3,Q4,Q5,Q6,Q7,Q8,Q9,Q10,Q11;CORROSIVE EFFECTS: Q2;CREEP; EQUIPMENT;FATIGUE;GAS TURBINES;HASTELLOY X: T7;HELIUM: T2;HTGR TYPE REACTORS: T1;INCONEL ALLOYS: T4;MANAURITE 36X: T8; MATERIALS TESTING;MICROSTRUCTURE: Q3,Q4;NICHROME: T3;REACTOR MATERIALS: Q1;RENE 80: T10;RUPTURES

G-38

ACCESSION NO.	80R0049009
TITLE(MONO)	DEVELOPMENT OF HIGH-TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO A TECHNOLOGY READINESS STATUS PHASE II. QUARTERLY REPORT, OCTOBER-DECEMBER 1979
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). GAS TURBINE DIV.
PAGE NO	129
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-1806
DATE	1979
CATEGORIES	EDB-200102
PRIMARY CAT	EDB-200102
REPORT NO	FE--1806-76
ABSTRACT	THE OBJECTIVE OF THE DOE-HTTT (HIGH-TEMPERATURE TURBINE TECHNOLOGY) PROGRAM IS TO BRING TO TECHNOLOGY READINESS, OVER A SIX- TO TEN-YEAR DURATION, A HIGH-TEMPERATURE GAS TURBINE FOR USE IN A COMBINED-CYCLE POWER PLANT, WITH COAL-DERIVED FUEL, AT A FIRING TEMPERATURE OF 2600$SUP 0$F AND WITH GROWTH CAPABILITY TO 3000$SUP 0$F. THIS PROGRAM HAS BEEN DIVIDED INTO THREE PHASES: PHASE I - PROGRAM AND SYSTEM DEFINITION; PHASE II - TECHNOLOGY TESTING AND TEST SUPPORT STUDIES; AND PHASE III - TECHNOLOGY READINESS VERIFICATION TEST PROGRAM. PHASE I WAS COMPLETED, AND PHASE II COMMENCED ON AUGUST 1, 1977. THE OBJECTIVES OF PHASE II ARE TO: (1) PERFORM COMPONENT DESIGN AND TECHNOLOGY TESTING IN CRITICAL AREAS; (2) PERFORM SYSTEM DESIGN AND TRADE-OFF ANALYSES IN SUFFICIENT DEPTH TO SUPPORT THE COMPONENT DESIGN AND TEST TASKS; AND (3) UPDATE THE PHASE I COMBINED-CYCLE PLANT STUDIES TO EVALUATE THE COMMERCIAL VIABILITY OF GE-THV GAS TURBINE SYSTEM. PROGRESS IN THESE ACTIVITIES IS REPORTED.
DESCRIPTORS	COMBINED-CYCLE POWER PLANTS: T1;COMBUSTION;COMBUSTORS;CORROSION; DESIGN: Q2;GAS TURBINES: T2,Q1;LOW BTU GAS;MATERIALS TESTING; OPERATION;PE[illegible]RMANCE TESTING: Q2;RESEARCH PROGRAMS: Q2;VERY HIGH TEMPERA[illegible]:

G-39

ACCESSION NO.	80R0044416
TITLE(MONO)	SUMMARY OF RESEARCH AND DEVELOPMENT EFFORT ON AIR AND WATER COOLING OF GAS TURBINE BLADES
EDITOR OR COMP	FRAAS, A.P.
CORPORATE AUTH	OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO	52
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-26
DATE	MAR 1980
CATEGORIES	EDB-200101;200104
PRIMARY CAT	EDB-200101
REPORT NO	ORNL/TM--6254
ABSTRACT	THE REVIEW ON AIR- AND WATER-COOLED GAS TURBINES FROM THE 1904 LEMALE-ARMENGAUD WATER-COOLED GAS TURBINE, THE 1948 TO 1952 NACA WORK, AND THE PROGRAM AT GE INDICATES THAT THE POTENTIAL OF AIR COOLING HAS BEEN LARGELY EXPLOITED IN REACHING TEMPERATURES OF 1100$SUP 0$C (APPROX. 2000$SUP 0$F) IN UTILITY SERVICE AND THAT FURTHER INCREASES IN TURBINE INLET TEMPERATURE MAY BE OBTAINED WITH WATER COOLING. THE LOCAL HEAT FLUX IN THE FIRST-STAGE TURBINE ROTOR WITH WATER COOLING IS VERY HIGH, YIELDING HIGH-TEMPERATURE GRADIENTS AND SEVERE THERMAL STRESSES. ANALYSES AND TESTS INDICATE THAT BY EMPLOYING A BLADE WITH AN OUTER CLADDING OF AN APPROX. 1-MM-THICK OXIDATION-RESISTANT HIGH-NICKEL ALLOY, A SUBLAYER OF A HIGH-THERMAL-CONDUCTIVITY, HIGH-STRENGTH, COPPER ALLOY CONTAINING CLOSELY SPACED COOLING PASSAGES APPROX. 2 MM IN ID TO MINIMIZE THERMAL GRADIENTS, AND A CENTRAL HIGH-STRENGTH ALLOY STRUCTURAL SPAR, IT APPEARS POSSIBLE TO OPERATE A WATER-COOLED GAS TURBINE WITH AN INLET GAS TEMPERATURE OF 1370$SUP 0$C. THE COOLING-WATER PASSAGES MUST BE LINED WITH AN IRON-CHROME-NICKEL ALLOY MUST BE BENT 90$SUP 0$ TO EXTEND IN A NEATLY SPACED ARRAY THROUGH THE PLATFORM AT THE BASE OF THE BLADE. THE COMPLEX GEOMETRY OF THE BLADE DESIGN PRESENTS TRULY FORMIDABLE FABRICATION PROBLEMS. THE WATER FLOW RATE TO EACH OF MANY THOUSANDS OF COOLANT PASSAGES MUST BE METERED AND HELD TO WITHIN RATHER CLOSE LIMITS BECAUSE THE HEAT FLUX IS SO HIGH THAT A LOCAL FLOW INTERRUPTION OF ONLY A FEW SECONDS WOULD LEAD TO A SERIOUS FAILURE.HEAT LOSSES TO THE COOLING WATER WILL RUN APPROX. 10% OF THE HEAT FROM THE FUEL. BY RECOVERYING THIS WASTE HEAT FOR FEEDWATER HEATING IN A COMMAND CYCLE, THESE HEAT LOSSES WILL GIVE A DEGRADATION IN THE POWER PLANT OUTPUT OF APPROX. 5% RELATIVE TO WHAT MIGHT BE OBTAINED IF NO COOLING WERE REQUIRED. HOWEVER, THE ASSOCIATED POWER LOSS IS LESS THAN HALF THAT TO BE EXPECTED WITH AN ELEGANT AIR COOLING SYSTEM.
DESCRIPTORS	AIR;COOLING: T3,Q2;COPPER ALLOYS;DESIGN;EXPERIMENTAL DATA: D; FATIGUE;GAS TURBINES: T1,D;GRAPHS: D;HEAT LOSSES;HEAT RECOVERY; HEAT TRANSFER;MATERIALS;PHYSICAL PROPERTIES;PIPES;POWER PLANTS; RESEARCH PROGRAMS: Q3;REVIEWS;TABLES: D;TESTING;THERMAL CONDUCTIVITY;TURBINE BLADES: T2,Q1;WASTE HEAT;WATER

G-40

ACCESSION NO.	80R0041440
TITLE(MONO)	GAS TURBINE DEMONSTRATION OF PYROLYSIS-DERIVED FUELS. FIRST TECHNICAL PROGRESS REPORT, SEPTEMBER 1, 1978-MARCH 31, 1979
EDITOR OR COMP	JASAS, G.
CORPORATE AUTH	TELEDYNE CAE TURBINE ENGINES, TOLEDO, OH (USA)
PAGE NO	34
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT ET-78-C-03-1839
DATE	1979
CATEGORIES	EDB-421000;090100
PRIMARY CAT	EDB-421000
REPORT NO	SAN--1839-T1
ABSTRACT	THE OBJECTIVE OF THIS PROGRAM IS TO DEMONSTRATE THE FEASIBILITY OF UTILIZING PYROLYTIC OIL AND CHAR AS A FUEL FOR A COMBUSTION TURBINE ENGINE. THIS IS THE FIRST PHASE OF AN EXTENDED PROGRAM WITH THE ULTIMATE GOAL OF COMMERCIALIZING A GAS TURBINE ENGINE AND ELECTRICAL GENERATING SYSTEM WHICH IS INDEPENDENT OF PETROLEUM-BASED FUELS. MAXIMUM USE OF EXISTING TECHNOLOGY AND CURRENT PRODUCTION ENGINE HARDWARE (TELEDYNE CAE MODEL J69-T-29 TURBOJET ENGINE) IS BEING INCORPORATED FOR A SEQUENCE OF TEST EVALUATIONS RANGING FROM ISOLATED COMBUSTOR COMPONENT TESTS TO FULL SCALE ENGINE DEMONSTRATION TESTS. THE TECHNICAL GOALS TO BE ACHIEVED DURING THE COURSE OF THIS PROJECT ARE: PYROLYTIC FUEL CHARACTERIZATION IN TERMS OF ITS PROPERTIES AND CONSTITUENTS; PYROLYTIC FUEL COMBUSTION TECHNOLOGY IN A GAS TURBINE APPLICATION IN TERMS OF PYROLYTIC OIL ATOMIZATION, QUANTITY OF CHAR BURNED, EMISSIONS, PERFORMANCE AND ASSOCIATED COMBUSTION SYSTEM AEROTHERMODYNAMICS; PYROLYTIC FUEL (OIL AND CHAR SLURRY) HANDLING, MIXING, AND STORAGE TECHNOLOGY; AND ENGINE MATERIALS COMPATIBILITY WITH THE PYROLYTIC FUEL AND ITS COMBUSTION PRODUCTS. THE PROGRAM HAS BEEN PLANNED, HARDWARE IS BEING PROCURED, AND DESIGN OF THE COMBUSTOR AND PYROLYTIC FUEL COMBUSTION ANALYSIS STUDIES ARE UNDERWAY.
DESCRIPTORS	AGRICULTURAL WASTES: 12;COMBUSTION PRODUCTS: Q4,D;COMBUSTORS: DESIGN;GAS TURBINES: T1;GRAPHS: D;NUMERICAL DATA: D;OPERATION; PYROLYSIS: Q2;PYROLYTIC OILS: T4,D;REFUSE DERIVED FUELS: Q1; RESEARCH PROGRAMS;VISCOSITY: Q4,D

G-41

ACCESSION NO.	80X0040787
TITLE(MONO)	DEVELOPMENT OF A CERAMIC TUBE HEAT EXCHANGER WITH RELAXING JOINT. QUARTERLY TECHNICAL PROGRESS REPORT, APRIL 1-JUNE 30, 1979
EDITOR OR COMP	WARD, M.E.; GOLDEN, M.E.; SOLOMON, N.G.; METCALFE, A.G.
CORPORATE AUTH	SOLAR TURBINES INTERNATIONAL, SAN DIEGO, CA (USA)
PAGE NO	33
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EF-77-C-01-2556
DATE	15 JUL 1979
CATEGORIES	EDB-360200;420400
PRIMARY CAT	EDB-360200
REPORT NO	FE--2556-26
ABSTRACT	CERAMIC TUBES FROM THE ENVIRONMENTAL TESTS HAVE BEEN EXAMINED AND ANALYZED. BOTH NC-430 AND SUPER KT SIC EXHIBITED NO SIGNIFICANT CHANGE IN STRUCTURE, AND MINOR DIMENSIONAL CHANGE AFTER THE 1000 HOUR EXPOSURE. A REDUCTION IN TUBE THICKNESS AT THE LEADING EDGE OCCURRED WITH THE ALPHA-SINTERED SIC TUBES. THE PROBABLE CAUSE OF MATERIAL LOSS OF THE TUBES IS ACCELERATED OXIDATION DUE TO IMPINGEMENT OF CONTAMINANTS WHICH ACTED TO FRACTURE, DISSOLVE AND WASH AWAY THE NORMALLY PURE SILICA PROTECTIVE LAYER THAT FORMS ON THE CARBIDE. NO STRUCTURAL OR DIMENSIONAL CHANGES WERE OBSERVED FOR ANY OF THE TUBE MATERIALS AFTER THE 100 HOUR TEST WITH V$SUB 2$O$SUB 5$ CONTAMINANT. TEST MODULE CONSTRUCTION CONTINUED WITH THE GRINDING OF THE EIGHT FOOT TUBES AND BRAZING OF THE TUBE SEGMENTS TO FORM 15 FOOT LONG TUBES. FORTY-SIX EIGHT-FOOT LONG TUBES HAVE BEEN RECEIVED.
DESCRIPTORS	CERAMICS;FLY ASH;GAS TURBINES;HEAT EXCHANGERS: T1;JOINTS; MATERIALS: Q1;MICROSCOPY;OXIDATION;SILICON CARBIDES;VANADIUM OXIDES

G-42

ACCESSION NO.	80R0040045
TITLE(MONO)	DEVELOPMENT OF HIGH TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO A TECHNOLOGY READINESS STATUS, PHASE II. PROGRESS REPORT, MAY 1979
EDITOR OR COMP	HORNER, M.W.
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). GAS TURBINE DIV.
PAGE NO	54
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-1806
DATE	10 JUN 1979
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
REPORT NO	FE--1806-68
ABSTRACT	PROGRESS IN THE DESIGN, FABRICATION AND TESTING OF COMPONENTS FOR HIGH TEMPERATURE GAS TURBINES FOR COMBINED-CYCLE POWER PLANTS IS REPORTED. HOT GAS PATH DEVELOPMENT TEST STAND FABRICATION IS CONTINUING. THE FABRICATION STATUS OF THE TWO FIRST STAGE NOZZLES TO BE TESTED IN THE TURBINE SIMULATOR IS REPORTED. SHOCK TUNNEL TEST SECTION CALIBRATION DATA IS PRESENTED WHICH VERIFIES THE NEW LOCATION OF THE TIME OF ARRIVAL SENSORS. ALL CONSTRUCTION WORK ON THE PGCUS IS COMPLETED. AERODYNAMIC COMPONENT TESTING OF ENDWALL CONFIGURATIONS HAS STARTED. TESTING OF THE NEW RADIAL CHANNEL HEAT TRANSFER SPECIMENS IN THE MOTORIZED TEST RIG IS CONTINUING. A CORRECTION FACTOR TO BE USED WITH THE AIR TURBINE HEAT TRANSFER TEST RESULTS, TO ACCOUNT FOR THE INOPERATIVE LEADING EDGE HEATERS WHEN THE TEST WAS CONDUCTED, IS PRESENTED. AN ANALYSIS OF THE COMPRESSOR DISCHARGE CASING STRUT SPRING RATES WAS COMPLETED. FEATURES TO EXPEDITE THE FABRICATION OF THE SECTORAL COMBUSTOR TO BE TESTED IN THE HGPDTS ARE DISCUSSED. ADDITIONAL DETAILS REGARDING THE COMBUSTOR DESIGN ANALYSIS ARE PRESENTED. ALL PLANNED WIND TUNNEL TESTING IN SUPPORT OF THE COMBUSTOR DEVELOPMENT HAVE BEEN COMPLETED. DATA FROM THE MOST RECENTLY COMPLETED HEAT TRANSFER COEFFICIENT TEST ARE BEING REDUCED. A RE-EVALUATION OF THE THERMAL STRAIN IN THE TRAILING EDGE OF THE FIRST STAGE NOZZLE, WITH THE EFFECTS OF THE INITIAL HOT ISOSTATICALLY PRESSED (HIP) CYCLE SUPERIMPOSED, HAS BEEN COMPLETED. THE DESIGN REMAINS COMPATIBLE WITH THE LCF DESIGN CRITERIA. AN ALTERNATIVE CONCEPT FOR CONVECTIVE SHROUD COOLING IS DESCRIBED. COMPLETE STATUS OF THE MATERIALS AND PROCESSES, AND MECHANICS OF MATERIALS TASKS ARE DISCUSSED.
DESCRIPTORS	AERODYNAMICS;COMBINED-CYCLE POWER PLANTS: T1;COMBUSTORS: T3,Q2; DESIGN;EXPERIMENTAL DATA: D;FABRICATION;GAS TURBINES: T2,Q1,D; GRAPHS: D;HEAT TRANSFER;LOW BTU GAS;MATERIALS TESTING;OPERATION; PERFORMANCE TESTING: Q2,Q3;RESEARCH PROGRAMS;TABLES: D;TEST FACILITIES: Q2;VERY HIGH TEMPERATURE

G-43

ACCESSION NO.	80C0039594
REPORT NO,PAGE	SERI/TP--31-248(VOL.2)(PT.1 PP. 177-185
TITLE	HIGH TEMPERATURE OXIDATION OF MATERIALS IN SOLAR THERMAL CONVERSION SYSTEMS UTILIZING A GAS COOLANT
AUTHORS	STRINGER, J.
AUTHOR AFF	EPRI, PALO ALTO, CA
TITLE(MONO)	RELIABILITY OF MATERIALS FOR SOLAR ENERGY. VOLUME II, PART 1. WORKSHOP PROCEEDINGS
SEC REPT NO	CONF-781228--(VOL.2)(PT.1)
PAGE NO	177-185
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	RELIABILITY OF MATERIALS FOR SOLAR ENERGY WORKSHOP
CONF PLACE	DENVER, CO, USA
CONF DATE	18 DEC 1978
DATE	OCT 1979
CATEGORIES	EDB-140700;360105
PRIMARY CAT	EDB-140700
REPORT NO	SERI/TP--31-248(VOL.2)(PT.1)
ABSTRACT	SOLAR THERMAL CONVERSION SYSTEMS UTILIZING A GAS COOLANT MAY EMPLOY EITHER AIR OR HELIUM AS THE COOLANT; THE HEAT EXCHANGER MAY BE EITHER METALLIC OR CERAMIC. IN MOST SCHEMES THE ENTHALPY IS EXTRACTED FROM THE HEATED GAS BY A GAS TURBINE. IN GENERAL,

	IT APPEARS THAT MECHANICAL PROPERTIES ARE A MORE IMPORTANT LIMITATION THAN THE OXIDATION RESISTANCE ON THE MAXIMUM GAS TEMPERATURE ATTAINABLE. A BRIEF OUTLINE OF THE IMPORTANT ASPECTS OF THE OXIDATION OF MATERIALS IS PRESENTED.
DESCRIPTORS	AIR;ALLOYS;CERAMICS;GAS TURBINES;GASES;HEAT RESISTING ALLOYS; HEAT TRANSFER FLUIDS;HELIUM;HIGH TEMPERATURE;IMPURITIES; MATERIALS: T1,Q2;METALS;OXIDATION: Q1;SOLAR RECEIVERS;SOLAR THERMAL POWER PLANTS: T2

G-44

ACCESSION NO.	80C0039592
REPORT NO.PAGE	SERI/TP--31-248(VOL.2)(PT.1 PP. 143-148
TITLE	DESIGN OF STRUCTURAL CERAMIC COMPONENTS FOR SOLAR HIGH TEMPERATURE THERMAL CONVERSION WITH A GAS COOLANT
AUTHORS	KOTCHICK, D.M.
AUTHOR AFF	GARRETT AIRESEARCH MFG. OF CALIFORNIA, TORRANCE
TITLE(MONO)	RELIABILITY OF MATERIALS FOR SOLAR ENERGY. VOLUME II. PART 1. WORKSHOP PROCEEDINGS
SEC REPT NO	CONF-781228--(VOL.2)(PT.1)
PAGE NO	143-148
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	RELIABILITY OF MATERIALS FOR SOLAR ENERGY WORKSHOP
CONF PLACE	DENVER, CO, USA
CONF DATE	18 DEC 1978
DATE	OCT 1979
CATEGORIES	EDB-140700
PRIMARY CAT	EDB-140700
REPORT NO	SERI/TP--31-248(VOL.2)(PT.1)
ABSTRACT	NONE
DESCRIPTORS	AIR HEATERS;BRAYTON CYCLE POWER SYSTEMS: T1;CERAMICS; CLOSED-CYCLE SYSTEMS;DESIGN;DUCTS;GAS TURBINES;GASES;HEAT EXCHANGERS;HEAT TRANSFER FLUIDS;MATERIALS: Q1,Q2;ROTORS;SEALS; SOLAR THERMAL POWER PLANTS: T2

G-45

ACCESSION NO.	80C0035459
REPORT NO.PAGE	CONF-7904105 PP. 370-377
TITLE	GAS TURBINE TRANSIT BUS DEMONSTRATION PROGRAM
AUTHORS	ROSS, R.J.
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS CONTRACTORS' COORDINATION MEETING. SIXTEENTH SUMMARY REPORT
PAGE NO	370-377
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	16. HIGHWAY VEHICLE SYSTEMS CONTRACTORS COORDINATION MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	24 APR 1979
DATE	SEP 1979
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-7904105--
ABSTRACT	THE OBJECTIVE OF THIS PROGRAM IS TO EVALUATE GAS TURBINE ENGINES IN ADVANCED DESIGN TRANSIT BUSES UNDER ACTUAL SERVICE CONDITIONS. THE GOALS ARE TO: (1) ACQUIRE OPERATIONAL AND ENGINEERING DATA; (2) DETERMINE BENEFITS TO TRANSIT PROPERTIES; AND (3) PROVIDE CATALYST FOR ENGINE COMMERCIALIZATION. THE EXPECTED NEAR-TERM BENEFITS ARE: (1) ALTERNATE FUELS; (2) REDUCED EMISSIONS; (3) INCREASED BRAKE LIFE; (4) ELIMINATION OF ENGINE COOLING SYSTEM; AND (5) INCREASED PASSENGER COMFORT. THE POTENTIAL LONG-TERM BENEFITS ARE EXPECTED TO BE: (1) FUEL ECONOMY; AND (2) REDUCED MAINTENANCE COSTS.
DESCRIPTORS	BUSES: T1;DEMONSTRATION PROGRAMS: Q2;GAS TURBINES: T2,Q1

G-46

ACCESSION NO.	80C0035458
REPORT NO.PAGE	CONF-7904105 PP. 367-369
TITLE	GREYHOUND/DOE TURBINE-POWERED INTERCITY BUS DEMONSTRATION PROGRAM
AUTHORS	MACKENZIE, M.G.
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS CONTRACTORS' COORDINATION MEETING. SIXTEENTH SUMMARY REPORT
PAGE NO	367-369
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	16. HIGHWAY VEHICLE SYSTEMS CONTRACTORS COORDINATION MEETING
CONF PLACE	DEARBORN, MI, USA

CONF DATE 24 APR 1979
DATE SEP 1979
CATEGORIES EDB-330103
PRIMARY CAT EDB-330103
REPORT NO CONF-7904105--
ABSTRACT GREYHOUND LINES INC. (GLI) AND THE US DEPARTMENT OF ENERGY (DOE) HAVE EMBARKED ON A COMPREHENSIVE DEMONSTRATION TEST PROGRAM TO EVALUATE A NEW, MORE PROMISING DESIGN OF DETROIT DIESEL ALLISON (DDA) GAS TURBINE ENGINES. THESE ENGINES WILL BE INTEGRATED WITH FOUR HEAVY-DUTY INTERCITY COACHES WHICH WILL OPERATE IN REVENUE SERVICE OVER ROUTES MUTUALLY AGREED UPON BY GLI AND DOE. (TFD)
DESCRIPTORS BUSES: T1;DEMONSTRATION PROGRAMS: Q2;GAS TURBINES: T2,Q1

G-47
ACCESSION NO. 80R0034492
TITLE(MONO) LIGHTWEIGHT PROPULSION SYSTEMS FOR ADVANCED NAVAL SHIP APPLICATIONS. PART II. CONCEPTUAL DESIGN AND RELIABILITY ANALYSIS. ANNUAL TECHNICAL REPORT
EDITOR OR COMP KUO, S.C.; MURTON, T.L.O.; SHU, H.; DEANE, C.W.; FISHER, E.R.
CORPORATE AUTH UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CT (USA)
PAGE NO 263
AVAILABILITY AVAILABILITY: MICROFICHE COPIES ONLY.
CONTRACT NO CONTRACT N00014-77-C-0735
DATE NOV 1978
CATEGORIES EDB-220800
PRIMARY CAT EDB-220800
REPORT NO AD-A--062746
ABSTRACT THIS REPORT PRESENTS THE RESULTS OF CONCEPTUAL DESIGN STUDIES AND RELIABILITY ANALYSES AS PART OF A COMPREHENSIVE STUDY PROGRAM TO EVALUATE THE TECHNOLOGICAL AND ECONOMIC FEASIBILITY OF UTILIZING OPEN- AND CLOSED-CYCLE GAS TURBINES INTEGRATED WITH FOSSIL OR NUCLEAR HEAT SOURCES FOR PROVIDING ADVANCED LIGHTWEIGHT PROPULSION POWER FOR FUTURE NAVY CAPITAL SHIP APPLICATIONS. THE LEVEL OF TECHNOLOGY CONSIDERED IS THAT JUDGED BY THE CONTRACTOR TO BE AVAILABLE DURING THE 1990'S.
DESCRIPTORS CLOSED-CYCLE SYSTEMS;DESIGN: Q2;GAS TURBINES: T2,Q1;HELIUM; RELIABILITY: Q2;SHIP PROPULSION REACTORS: T1;WEIGHT

G-48
ACCESSION NO. 80J0034065
TITLE DEVELOPMENTS IN STEAM AND GAS TURBINES. A LITERATURE SURVEY
AUTHORS THOMAS, H.J.
PUB DESC WAERME, V. 85, NO. 3, PP. 70-71
DATE JUN 1979
LANGUAGE IN GERMAN
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT NONE
DESCRIPTORS GAS TURBINES: T2;OPTIMIZATION;REVIEWS: Q1,Q2;STEAM TURBINES: T1

G-49
ACCESSION NO. 80J0034033
TITLE CONCEPTUAL DESIGN AND COST ESTIMATE 600 MWE COAL FIRED FLUIDIZED-BED COMBINED CYCLE POWER PLANT
AUTHORS HUBER, D.A.; COSTELLO, R.M.
PUB DESC COMBUSTION, V. 50, NO. 12, PP. 22-28
DATE JUN 1979
CATEGORIES EDB-200102
PRIMARY CAT EDB-200102
ABSTRACT A CONCEPTUAL DESIGN AND A COST ESTIMATE WERE MADE FOR THE U.S. DEPARTMENT OF ENERGY FOR A COMBINED CYCLE POWER PLANT USING PRESSURISED, FLUIDIZED BED COMBUSTORS AND GAS TURBINES, COUPLED WITH SUPPLEMENTARY FIRING OF THE GAS TURBINE EXHAUST IN AN ATMOSPHERIC FLUIDIZED BED STEAM GENERATOR. THE TECHNOLOGICAL ADVANCES REQUIRED FOR THIS TYPE OF SYSTEM ARE LESS DEMANDING THAN THOSE FOR OTHER ADVANCED COAL CONVERSION SYSTEMS.
DESCRIPTORS COMBINED-CYCLE POWER PLANTS: T1;COST;DESIGN: Q1;EVALUATION; FLUIDIZED-BED COMBUSTORS;GAS TURBINES;MEDIUM PRESSURE; PRESSURIZING;STEAM GENERATORS;TECHNOLOGY ASSESSMENT;USA

G-50
ACCESSION NO. 80J0033005
TITLE RELIABILITY OF GAS TURBINE POWERED COMPRESSOR UNITS
AUTHORS HARRISON, R.A.; WEATHERILT, P.F.
AUTHOR AFF BR GAS CORP, LONDON, ENGL
PUB DESC J. ENG. POWER, V. 101, NO. 1, PP. 73-78
DATE JAN 1979
CATEGORIES EDB-032000;425001
PRIMARY CAT EDB-032000
ABSTRACT PAPER NO. 78-GT-27.
DESCRIPTORS COMPRESSORS: T3,Q1;GAS TURBINES: T2,Q3;NATURAL GAS DISTRIBUTION SYSTEMS: T1;PIPELINES;RELIABILITY: Q2;SIMULATION

G-51
ACCESSION NO. 80R0029646
TITLE(MONO) REVIEW AND ANALYSIS OF SPRAY COMBUSTION AS RELATED TO ALTERNATIVE FUELS
EDITOR OR COMP BLACK, C.H.; CHIU, H.H.; FISCHER, J.; CLINCH, J.M.
CORPORATE AUTH ARGONNE NATIONAL LAB., IL (USA)
PAGE NO 44
AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT W-31-109-ENG-38
DATE SEP 1979
CATEGORIES EDB-400800;014000;025000;040500
PRIMARY CAT EDB-400800
REPORT NO ANL--79-77

ABSTRACT A REVIEW OF THE LITERATURE ON SPRAY COMBUSTION WAS CONDUCTED, WITH PARTICULAR EMPHASIS ON THEORETICAL AND EXPERIMENTAL WORK ON DROPLET AND SPRAY COMBUSTION RELEVANT TO THE USE OF ALTERNATE FUELS (MAINLY LIQUID FUELS DERIVED FROM COAL AND SHALE). PRINCIPAL DIFFERENCES BETWEEN COAL-DERIVED LIQUID FUEL AND PETROLEUM HAVE BEEN IDENTIFIED. COAL LIQUIDS HAVE A LOWER HYDROGEN-TO-CARBON RATIO, HIGHER AROMATIC COMPOUND CONTENT, GREATER TENDENCY TO FORM SOOT, AND BURN WITH A MORE LUMINOUS FLAME. COAL LIQUIDS POSE POTENTIAL CARCINOGENIC HAZARDS IN HANDLING THE FUEL AND FROM SOOT RESULTING FROM THEIR COMBUSTION. COAL LIQUIDS ARE LESS STABLE THAN PETROLEUM, CONTAIN CONSIDERABLY MORE ORGANIC NITROGEN, PRODUCE MORE NO/SUB X/ WHEN BURNED, AND CONTAIN LESS SULFUR. THEY ALSO CONTAIN A BROADER RANGE OF VOLATILES, AND SPRAY DROPLETS OF COAL LIQUIDS UNDERGO SWELLING, DISRUPTIVE BOILING, MICROEXPLOSIONS, LIQUID-PHASE PYROLYSIS, AND HAVE GREATER RADIATIVE EFFECTS. ALTHOUGH DEMONSTRATION TESTS HAVE SHOWN THAT COAL LIQUIDS CAN BE BURNED IN VARIOUS COMBUSTING DEVICES, SUCH AS GAS TURBINES, DIESEL ENGINES, UTILITY BOILERS, AND RESIDENTIAL FURNACES, THESE TESTS HAVE IDENTIFIED PROBLEMS THAT MAY BE ENCOUNTERED: PLUGGING AND FOULING OF FUEL NOZZLES, INCREASED NO/SUB X/ EMISSIONS, HOT CORROSION OF TURBINE BLADES, COOLING-HOLE PLUGGING, IRREGULAR BURNING, HIGHER COMBUSTOR-WALL TEMPERATURES, GREATER SOOT FORMATION, AND VARIABILITY BETWEEN COAL-LIQUID SAMPLES. ALTHOUGH CONSIDERABLE PROGRESS HAS BEEN MADE IN UNDERSTANDING THE SPRAY COMBUSTION PROCESSES OF NORMAL PETROLEUM LIQUIDS, CONSIDERABLE RESEARCH WORK IS NEEDED IN THE AREA OF SPRAY COMBUSTION OF ALTERNATE FUELS. FURTHERMORE, THE LITERATURE INDICATES THAT SPRAY COMBUSTION OF FUELS SIMILAR TO COAL LIQUIDS IS CONSIDERABLY MORE COMPLEX, AND THAT A MAJOR RESEARCH EFFORT IS REQUIRED IN ANTICIPATION OF SIGNIFICANT SUBSTITUTION OF COAL LIQUIDS FOR IMPORTED PETROLEUM FUELS.

DESCRIPTORS AROMATICS;ATOMIZATION: Q1,Q2,Q3,Q4;CARCINOGENS;COAL LIQUIDS: T2; COMBUSTION: Q1,Q2,Q3,Q4;DIESEL ENGINES;DROPLETS;FUEL OILS: T1; GAS TURBINES;NITROGEN OXIDES;ORGANIC NITROGEN COMPOUNDS;REVIEWS; SHALE OIL: T3;SPRAYS;STABILITY;SULFUR;SYNTHETIC FUELS: T4

G-52 ACCESSION NO. 80P0028109
PATENT NO US PATENT 4,117,343
TITLE(MONO) TURBO-MACHINE PLANT HAVING OPTIONAL OPERATING MODES
EDITOR OR COMP HOFFEINS, H.
PAT ASSIGNEE TO BROWN BOVERI-SULZER TURBOMASCHINEN AG
FILED DATE PRIORITY DATE 8 NOV 1973, GERMAN, FEDERAL REPUBLIC OF (F.R. GERMANY)
PAGE NO 4
DATE 26 SEP 1978
CATEGORIES EDB-250200
PRIMARY CAT EDB-250200
AUGMENTATION PATENT
ABSTRACT A TURBO-MACHINE PLANT COMPRISES A GAS TURBINE CONNECTED TO A SYNCHRONOUS ELECTRICAL MACHINE BY WAY OF AN OVER-RIDING CLUTCH AND A COMPRESSOR CONNECTED TO THE ELECTRICAL MACHINE BY WAY OF A DISCONNECTIBLE COUPLING. THE MACHINE GROUP IS OPERABLE IN TWO DIFFERENT MODES. IN ONE MODE, THE ELECTRICAL MACHINE FUNCTIONS AS A MOTOR FOR DRIVING THE COMPRESSOR WHICH DELIVERS AIR TO AN AIR STORAGE CHAMBER AND THE GAS TURBINE IS AUTOMATICALLY DISCONNECTED FROM THE ELECTRICAL MACHINE BY THE OVER-RIDING CLUTCH. TO CHANGE OVER TO THE OTHER OPERATIONAL MODE THE POWER ABSORPTION OF THE COMPRESSOR IS FIRST REDUCED TO A LOW LEVEL, AND THE GAS TURBINE IS THEN BROUGHT UP TO SYNCHRONOUS SPEED AND BECOMES COUPLED TO THE ELECTRICAL MACHINE WHICH THEN OPERATES FOR CURRENT GENERATION.
DESCRIPTORS COMPRESSED AIR STORAGE POWER PLANTS: M1;COMPRESSORS;ELECTRIC GENERATORS;GAS TURBINES;OPERATION: Q2;TURBOMACHINERY: M2,Q1

G-53 ACCESSION NO. 80C0027708
TITLE START-UP AND SHUT-DOWN AS WELL AS PART-LOAD PERFORMANCE OF POWER PLANTS WITH FLUIDIZED BED COMBUSTION
AUTHORS PLACKMEYER, J.
TITLE(MONO) WIRBELSCHICHTFEUERUNG. GRUPPE 3: KOMPONENTEN UND TEILPROBLEME
PAGE NO 139-145
CONF TITLE CONFERENCE ON FLUIDIZED-BED COMBUSTION
CONF PLACE DUESSELDORF, GERMANY, F.R.
CONF DATE 6 - 7 NOV 1978
PUBL LOC VDI-VERL., DUESSELDORF, GERMANY, F.R.
DATE 1978
LANGUAGE IN GERMAN
CATEGORIES EDB-200104;014000
PRIMARY CAT EDB-200104
ABSTRACT FOR A GAS TURBINE PLANT WITH FLUIDIZED BED COMBUSTION THE START-UP PERFORMANCE IS STUDIED BY CALCULATION. THERE ARE PRESENTED TWO WAYS OF STARTING UP TO FULL LOAD AND ONE TO PARTLOAD. FOR THIS PURPOSE THE TIME BEHAVIOR OF THE GAS AND PIPE TEMPERATURES AS WELL AS OF THE OPERATING PRESSURE AND THE POWER IS SHOWN. MOREOVER, THE EXPANSION AND ASH REMOVAL PERFORMANCE OF THE FLUIDIZED BED IS ILLUSTRATED. ADVANTAGES AND DISADVANTAGES OF THE DIFFERENT WAYS OF START-UP ARE DISCUSSED. IN ADDITION, THERE WERE STUDIED POSSIBLE ACCIDENTS ON START-UP AND DISCUSSED CONSEQUENCES AS WELL AS REMEDIAL MEASURES. TO CONCLUDE WITH, NECESSARY MEASURES IN SHUTTING-DOWN THE PLANT WERE DISCUSSED.
DESCRIPTORS COAL;FLUIDIZED-BED COMBUSTORS: T1,Q2;FOSSIL-FUEL POWER PLANTS: T2;GAS TURBINES;IGNITION;OPERATION: Q1;PILOT PLANTS;PRESSURE DEPENDENCE;TIME DEPENDENCE

G-54

TITLE(MONO)	SRC-II DEMONSTRATION PROJECT. PHASE ZERO. TASK NUMBER 3: DELIVERABLE NUMBER 9. VOLUME 2. MARKET ASSESSMENT: COMBUSTION TEST PROGRAM. SUPPORTING RESULTS
CORPORATE AUTH	PITTSBURGH AND MIDWAY COAL MINING CO.. DENVER. CO (USA)
PAGE NO	581
AVAILABILITY	DEP. NTIS. PC A25/MF A01.
CONTRACT NO	CONTRACT ET-78-C-01-3055
DATE	31 JUL 1979
CATEGORIES	EDB-015000;010405;200108;294001;010600
PRIMARY CAT	EDB-015000
REPORT NO	FE--3055-T1(VOL.2)
ABSTRACT	A NUMBER OF COMBUSTION TESTS OF SRC-II FUEL OIL HAVE BEEN CONDUCTED WITH FINANCIAL SUPPORT FROM GULF. EPRI. AND OTHER ORGANIZATIONS. REPORTS FROM THE TESTS INCLUDED IN THIS VOLUME PROVIDE INFORMATION ABOUT THE TECHNICAL FEASIBILITY OF SRC-II FUEL OIL USE IN VARIOUS MARKETS. THIS SECTION PROVIDES TECHNICAL ABSTRACTS AND HIGHLIGHTS OF EACH TEST AND OFFERS SOME INTERPRETIVE COMMENTS TO POINT OUT ISSUES. PLACE ITEMS IN CONTEXT. AND OFFER ALTERNATIVE SOLUTIONS TO PROBLEMS. A TABLE INDICATES THE VARIOUS BOILER AND BURNER-DESIGNS AND FLAME CONFIGURATIONS FOR EMISSIONS SUPPRESSION IN EACH TEST. THE SUCCESS OF THESE DESIGNS IN SUPPRESSING EMISSIONS FROM SRC-II FUEL OIL COMBUSTION IS INDICATED BY THE RESULTING NO/SUB X/ CONCENTRATIONS. FUEL-NO YIELDS. SMOKE NUMBERS AND PARTICULATES CONCENTRATIONS. COMMENTS ABOUT EACH TEST ARE SUMMARIZED.
DESCRIPTORS	AIR POLLUTION CONTROL;BOILERS;BURNERS;COAL LIQUEFACTION;COAL LIQUIDS: T2.D;COMBUSTION: Q2.D;DEMONSTRATION PLANTS: Q1;DESIGN; ELECTRIC UTILITIES;EXPERIMENTAL DATA: D;FUEL OILS;GAS TURBINES; GRAPHS: D;MARKET: Q2;MIXING;NITROGEN OXIDES;PERFORMANCE TESTING: Q2.D;PHYSICAL PROPERTIES;SRC-II PROCESS: T1;TABLES: D

G-55

ACCESSION NO.	80R0019547
TITLE(MONO)	SRC-II DEMONSTRATION PROJECT. PHASE ZERO. TASK NUMBER 3: DELIVERABLE NUMBER 9. VOLUME 1. MARKET ASSESSMENT: MARKET OPPORTUNITY FOR SRC-II FUEL OIL
CORPORATE AUTH	PITTSBURGH AND MIDWAY COAL MINING CO.. DENVER. CO (USA)
PAGE NO	674
AVAILABILITY	DEP. NTIS. PC A99/MF A01.
CONTRACT NO	CONTRACT ET-78-C-01-3055
DATE	31 JUL 1979
CATEGORIES	EDB-015000;010405;200108;294001;290500;010600
PRIMARY CAT	EDB-015000
REPORT NO	FE--3055-T1(VOL.1)
ABSTRACT	SRC-II FUEL OIL IS POTENTIALLY ATTRACTIVE AS A FUEL FOR GENERATING ELECTRIC POWER FOR THE FOLLOWING REASONS: (1) SRC-II FUEL OIL. AT PRESENTLY ESTIMATED COSTS. WOULD BE EXPECTED TO BE ECONOMICALLY COMPETITIVE WITH REPLACING OIL IN EXISTING OIL-FIRED BOILERS. FUELING NEW OIL-FIRED BOILERS IN EAST COAST URBAN LOCATIONS. AND FUELING NEW COMBINED CYCLE COMBUSTION TURBINES AT TODAY'S LEVEL OF TECHNOLOGY AND NEW ADVANCED COMBINED CYCLE COMBUSTION TURBINES AT FORECASTED LEVELS OF TECHNOLOGY REGARDLESS OF UTILITY LOCATION. (2) AT THE PROJECTED ESTIMATE OF SRC-II FUEL OIL COSTS. SRC-II FUEL OIL WOULD BE EXPECTED TO BE ECONOMICALLY COMPETITIVE IN EASTERN URBAN AREAS COMPARED TO OTHER MEANS OF COAL UTILIZATION FOR ELECTRIC POWER GENERATION. THIS INCLUDES BOILERS WITH FLUE GAS DESULFURIZATION. WITH ON-SITE OR OFF-SITE SLUDGE DISPOSAL. AND COAL GASIFICATION INTEGRATED WITH ADVANCED COMBINED CYCLE COMBUSTION TURBINES. (3) THE SRC-II FUEL OIL ALTERNATIVES WOULD HAVE THE ADDITIONAL ADVANTAGE OF BEING AN ENVIRONMENTALLY CLEAN METHOD OF GENERATION WHICH WOULD NOT PRESENT WASTE CONTROL PROBLEMS AT THE SITE OF ELECTRIC POWER GENERATION. THIS IS ESPECIALLY IMPORTANT FOR THE ELECTRIC POWER GENERATION DEMANDS OF THE POPULOUS EAST COAST REGION. WHEN THE ABOVE CONSIDERATIONS ARE COMBINED IN A UTILITY SYSTEMS ANALYSIS WITH THE HIGHER RELIABILITY OF SIMPLE-TO-OPERATE AND MAINTAIN OIL-FIRED GENERATING EQUIPMENT. THE SRC-II FUEL OIL ALTERNATIVES EMERGE HAVING THE POTENTIAL TO PROVIDE A LOWER REVENUE REQUIREMENT TO THE UTILITY SYSTEM. WHEN USED IN CONJUNCTION WITH NUCLEAR BASE LOAD POWER GENERATION. BY PROVIDING ELECTRIC POWER IN A BROAD RANGE OF LOAD CLASSIFICATION AND FOR REGIONS IN ADDITION TO EAST COAST URBAN AREAS. THE DOMINANT ECONOMIC THEME IS THE INABILITY OF THE DIRECT USE OF COAL ALTERNATIVES TO OFFSET THEIR HIGHER CAPITAL AND OPERATING COSTS WITH THE LOWER FUEL COST OF COAL. COMPARED TO THE ESTIMATED COST OF SRC-II FUEL OIL.
DESCRIPTORS	BOILER FUEL;CHEMICAL COMPOSITION: Q1;COAL: T2;COAL LIQUEFACTION; COAL LIQUIDS: T1;COMBINED-CYCLE POWER PLANTS;COMBUSTION: Q1; COMPARATIVE EVALUATIONS: Q1.Q2;DEMONSTRATION PLANTS;ECONOMIC ANALYSIS: Q1;ELECTRIC UTILITIES;FORECASTING;FOSSIL-FUEL POWER PLANTS: T3;FUEL OILS;FUEL SUBSTITUTION: Q3.Q4;GAS TURBINES; INDUSTRIAL PLANTS: T4;MARKET: Q1;NITROGEN OXIDES;PHYSICAL PROPERTIES: Q1;PRICES;REFINING: Q1;RETROFITTING;SRC-II PROCESS

G-56

ACCESSION NO.	80J0015683
TITLE	COAL DUST AS FUEL FOR INDUSTRIAL GAS TURBINES
AUTHORS	WITSCHAKOWSKI, W.
PUB DESC	MASCHINENMARKT. V. 84. NO. 5. PP. 74-76
DATE	JAN 1978
LANGUAGE	IN GERMAN
CATEGORIES	EDB-200108
PRIMARY CAT	EDB-200108
ABSTRACT	COMBUSTION PROPERTIES OF COAL DUST. WEAR PROBLEMS OF COAL-DUST-FIRED DIESEL ENGINES. AND COAL DUST OPERATING PROBLEMS OF GAS TURBINES ARE DISCUSSED.
DESCRIPTORS	COAL: T3;COMBUSTION PROPERTIES: Q3;DIESEL ENGINES: T1;DUSTS; FUELS: Q1.Q2;GAS TURBINES: T2;OPERATION;POWER GENERATION;WEAR

G-57
ACCESSION NO. 80H0015836
TITLE(MONO) LOW NO/SUB X/ HEAVY FUEL COMBUSTOR PROGRAM
EDITOR OR COMP LISTER, E.; NIEDZWIECKI, R.W.; NICHOLS, L.
CORPORATE AUTH DEPARTMENT OF ENERGY, WASHINGTON, DC (USA); NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO NASA-TM--79313
PAGE NO 15
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT EC-77-A-31-1062
DATE 1979
CATEGORIES EDB-200100;421000;240800
PRIMARY CAT EDB-200100
AUGMENTATION GAS TURBINES FOR CO-GENERATION
REPORT NO DOE/NASA/1062--79/3
ABSTRACT THE LOW NO/SUB X/ HEAVY FUEL COMBUSTOR PROGRAM IS A PART OF THE DOE/LERC ADVANCED CONVERSION TECHNOLOGY PROJECT (ACT). MAIN PROGRAM OBJECTIVES ARE TO GENERATE AND DEMONSTRATE THE TECHNOLOGY REQUIRED TO DEVELOP DURABLE GAS TURBINE COMBUSTORS FOR UTILITY AND INDUSTRIAL APPLICATIONS, WHICH ARE CAPABLE OF SUSTAINED, ENVIRONMENTALLY ACCEPTABLE OPERATION WITH MINIMALLY PROCESSED PETROLEUM RESIDUAL FUELS. THE PROGRAM WILL FOCUS ON DRY REDUCTIONS OF OXIDES OF NITROGEN (NO/SUB X/), IMPROVED COMBUSTOR DURABILITY AND SATISFACTORY COMBUSTION OF MINIMALLY PROCESSED PETROLEUM RESIDUAL FUELS. OTHER TECHNOLOGY ADVANCEMENTS SOUGHT INCLUDE: FUEL FLEXIBILITY FOR OPERATION WITH PETROLEUM DISTILLATES, BLENDS OF PETROLEUM DISTILLATES AND RESIDUAL FUELS, AND SYNFUELS (FUEL OILS DERIVED FROM COAL OR SHALE); ACCEPTABLE EXHAUST EMISSIONS OF CARBON MONOXIDE, UNBURNED HYDROCARBONS, SULFUR OXIDES AND SMOKE; AND RETROFIT CAPABILITY TO EXISTING ENGINES.
DESCRIPTORS AIR POLLUTION CONTROL: Q3;CO-GENERATION: M;COMBUSTORS: M2,Q1; FUELS;GAS TURBINES: M1;NITROGEN OXIDES: M3;PERFORMANCE;RESEARCH PROGRAMS: Q2

G-58
ACCESSION NO. 80J0012381
TITLE CATALYTIC COMBUSTION FOR SYSTEM APPLICATIONS
AUTHORS KRILL, W.V.; KESSELRING, J.P.; CHU, E.K.; KENDALL, R.M.
AUTHOR AFF ACUREX CORP, MOUNTAIN VIEW, CALIF
PUB DESC AM. SOC. MECH. ENG., _PAP.*, NO. 79-HT-54, PP. 1-9
DATE AUG 1979
CATEGORIES EDB-421000
PRIMARY CAT EDB-421000
ABSTRACT ADVANCES IN CATALYTIC COMBUSTION TECHNOLOGY HAVE LED TO LABORATORY TESTING OF SMALL SCALE SYSTEM CONCEPTS. THE POTENTIAL FOR THESE CONCEPTS IS ENHANCED BY ONGOING CATALYST DEVELOPMENT AND THE NEED FOR STRICTER EMISSION CONTROL. THREE SYSTEM CONCEPTS HAVE BEEN TESTED: A RADIATIVE CATALYST/WATERTUBE SYSTEM FOR APPLICATION TO WATERTUBE BOILERS, A MODEL GAS TURBINE COMBUSTOR, AND A TWO-STATE CATALYTIC COMBUSTOR. LOW THERMAL NO/SUB X/ AND HIGH COMBUSTION EFFICIENCY HAVE BEEN SHOWN FOR EACH. THE TWO-STAGE COMBUSTOR CONCEPT HAS APPLICATION TO BOTH BOILER AND TURBINE SYSTEMS WITH STRONG POTENTIAL FOR CONTROL OF FUEL NO/SUB X/. CONCEPTUAL DESIGNS FOR APPLICATION OF EACH COMBUSTOR TO EXISTING SYSTEMS AND REQUIRED AREAS OF DEVELOPMENT ARE PRESENTED. EXPERIMENTAL DATA FOR SYSTEM EMISSIONS SUPPORT THE CONCEPTUAL DESIGNS.
DESCRIPTORS AIR POLLUTION CONTROL;BOILERS: T1;CATALYTIC COMBUSTORS: T3,Q1,Q2;GAS TURBINES: T2;NITROGEN OXIDES;OPERATION: Q3;TUBES

G-59
ACCESSION NO. 80R0009846
TITLE(MONO) THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A CLOSED HOT-AIR TURBINE FOR OPERATING STATES VARYING WITH TIME
EDITOR OR COMP POESENTHUP, H.
CORPORATE AUTH TECHNISCHE UNIV. HANNOVER (GERMANY, F.R.). FAKULTAET FUER MASCHINENWESEN
PAGE NO 129
AVAILABILITY DEP. NTIS (US SALES ONLY), PC A07/MF A01.
DATE 25 JAN 1978
LANGUAGE IN GERMAN
DRUP NOTE THESIS
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
REPORT NO NP--24108
ABSTRACT A THEORETICAL MODEL IS DEVELOPED WHICH TAKES ACCOUNT OF HEAT EXCHANGE BETWEEN THE GAS AND THE ENCLOSING WALLS. PIPELINES AND APPARATUS ARE MODELLED BY FLOW CHANNELS WITH A NUMBER OF SUBSECTIONS. TWO FLOW CHANNELS WITH ONE COMMON WALL REPRESENT THE HEAT-EXCHANGING APPARATUS. QUASISTATIONARY BEHAVIOR OF THE TURBOMACHINERY IS ASSUMED. EXPERIMENTS WITH THE CLOSED HOT-AIR TURBINE OF ENERGIEVERSORGUNG OBERHAUSEN AG PROVE THE RELIABILITY OF THE METHOD OF CALCULATION.
DESCRIPTORS EXPERIMENTAL DATA: D;GAS TURBINES: T1,D;GRAPHS;HEAT TRANSFER; MATHEMATICAL MODELS: D;OPERATION: Q1,D;TABLES: D;THEORETICAL DATA: D

G-60
ACCESSION NO. 80P0009840
PATENT NO GERMAN(FRG) PATENT 2,714,179/A/
TITLE(MONO) PROCESS FOR ENERGY GENERATION IN A CLOSED CIRCUIT
EDITOR OR COMP POCRNJA, A.
PAT ASSIGNEE TO LINDE A.G., WIESBADEN (GERMANY, F.R.); DEUTSCHES PATENTAMT, MUENCHEN (GERMANY, F.R.)

PAGE NO	25
DATE	5 OCT 1978
LANGUAGE	IN GERMAN
CATEGORIES	EDB-200102
PRIMARY CAT	EDB-200102
AUGMENTATION	PATENT
ABSTRACT	THE CLAIM IS BASED ON IDEAS FOR COMBINING THE ADVANTAGES OF A CONDENSATION POWER STATION WITH THE ADVANTAGES OF A HOT AIR (GAS) TURBINE WHILE AVOIDING THE RESPECTIVE DISADVANTAGES. SO$SUB 2$ IS PROPOSED AS THE MEDIUM IN AN EXAMPLE OF AN APPLICATION, WHICH IS COMPRESSED FROM 5 TO 14.5 BAR BY A LIQUID PUMP, AND IS THEN EVAPORATED AT 75$SUP 0$C USING CHEEP WASTE HEAT, IS FURTHER HEATED IN THE REGENERATOR AND FINALLY REACHES A MAXIMUM TEMPERATURE OF 705$SUP 0$C IN THE BOILER. IT IS REDUCED IN PRESSURE TO 5 BAR IN A TURBINE, WHERE IT CARRIES OUT WORK, IS FURTHER COOLED IN THE REGENERATOR, AND IS THEN CONDENSED WITH COOLING WATER IN THE HEAT EXCHANGER AND RETURNED TO THE PUMP. IN COMPARISON WITH A HOT AIR TURBINE, WHERE A LARGE PART OF THE OUTPUT IS CONSUMED BY THE COMPRESSOR, THIS EXAMPLE PROVIDES A MUCH HIGHER CALCULATED EFFICIENCY, AS THE REQUIRED PUMP OUTPUT IS VERY LOW. IN A FURTHER EXAMPLE, CO$SUB 2$ IS PROPOSED AS THE CIRCUIT MEDIUM, WHICH EVAPORATES AT AMBIENT TEMPERATURES, BUT HAS TO BE COOLED BELOW -50$SUP 0$C FOR CONDENSATION. LIQUID NATURAL GAS FROM A LNG TANKER SHOULD BE TAKEN TO THE HEAT EXCHANGER FOR THIS PURPOSE. A MUCH HIGHER EFFICIENCY IS ALSO CALCULATED FOR THIS EXAMPLE, THAN FOR A HOT AIR TURBINE WITH LIQUID NATURAL GAS COOLING. IT IS ALSO PROPOSED TO USE SOLAR HEAT OR GEOTHERMAL HEAT FOR EVAPORATION.
DESCRIPTORS	CARBON DIOXIDE;COMPRESSORS;DESIGN;ENERGY CONVERSION;GAS TURBINES;HEAT EXCHANGERS;SULFUR DIOXIDE;THERMAL EFFICIENCY: Q1; THERMAL POWER PLANTS: M2;THERMODYNAMIC CYCLES: M1,Q2;WORKING FLUIDS

G-61

ACCESSION NO.	80J0006162
TITLE	DEVELOPMENT OF DUAL AND MULTI-FUEL GAS TURBINE
AUTHORS	SINGH, R.
PUB DESC	DIESEL GAS TURBINE PROG., V. 43, PP. 86-87
DATE	MAY 1977
CATEGORIES	EDB-421000
PRIMARY CAT	EDB-421000
ABSTRACT	THE KG2 GAS TURBINE HAS A NEW COMBUSTOR DESIGN FEATURING FOUR SEPARATE CUPS, EACH CONTAINING AN AIR SWIRLER AND FUEL NOZZLE THAT ALLOWS THE TURBINE TO BURN A VARIETY OF GASEOUS AND LIQUID FUELS. THE RADIAL TURBINE IMPELLER BLADES ARE RELATIVELY INSENSITIVE TO ASH BUILDUP AND THE EXHAUST IS CLEAN EVEN WITH CRUDE AND WAXY FUELS BECAUSE OF THE MODEST PRESSURE RATIO AND LARGE EXCESS OF OXYGEN.
DESCRIPTORS	COMBUSTORS: T2,Q1;DESIGN;GAS TURBINES: T1;NORWAY;OPERATION: Q2

G-62

ACCESSION NO.	80C0004668
REPORT NO.PAGE	CONF-791014 PP. VI.1-VI.9
TITLE	TECHNOLOGY FOR CERAMIC TUBE HEAT EXCHANGERS
AUTHORS	WARD, M.E.; GOLDEN, M.E.; METCALFE, A.G.
AUTHOR AFF	INTERNATIONAL HARVESTER CO., SAN DIEGO, CA
TITLE(MONO)	FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	VI.1-VI.9
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	9 OCT 1979
DATE	1979
CATEGORIES	EDB-200104;360203
PRIMARY CAT	EDB-200104
REPORT NO	CONF-791014--
ABSTRACT	NONE
DESCRIPTORS	CERAMICS;CLOSED-CYCLE SYSTEMS: Q1;COAL;COMBUSTION;DESIGN: Q2; GAS TURBINES: T1;HEAT EXCHANGERS: T2;JOINTS;MATERIALS: Q2; PERFORMANCE TESTING: Q2;SILICON CARBIDES

G-63

ACCESSION NO.	80C0004667
REPORT NO.PAGE	CONF-791014 PP. V.75-V.76
TITLE	IMPROVEMENT OF METALLIC COATINGS FOR GAS TURBINE AIRFOILS
AUTHORS	BEALE, H.A.
AUTHOR AFF	BATTELLE COLUMBUS LABS., OH
TITLE(MONO)	FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	V.75-V.76
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	9 OCT 1979
DATE	1979
CATEGORIES	EDB-200104;360105
PRIMARY CAT	EDB-200104
REPORT NO	CONF-791014--
ABSTRACT	NONE
DESCRIPTORS	COATINGS: Q1;GAS TURBINES;MATERIALS: Q1;MATERIALS TESTING; MATHEMATICAL MODELS;PEIERLS-NABARRO FORCE;TURBINE BLADES: T1

G-64
ACCESSION NO. 80C0004666
REPORT NO.PAGE CONF-791014 PP. V.67-V.68
TITLE EROSION STUDY IN TURBOMACHINERY AFFECTED BY COAL AND ASH PARTICLES
AUTHORS TABAKOFF, W.; HAMED, A.
AUTHOR AFF UNIV. OF CINCINNATI, OH
TITLE(MONO) FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO V.67-V.68
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE 4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE GAITHERSBURG, MD, USA
CONF DATE 9 OCT 1979
DATE 1979
CATEGORIES EDB-200104;360105;010404;014000
PRIMARY CAT EDB-200104
REPORT NO CONF-791014--
ABSTRACT NONE
DESCRIPTORS COAL;COAL GASIFICATION;COMBUSTION;COMBUSTION PRODUCTS: T1; CYCLONE SEPARATORS;DENSITY;EROSION: Q4;FORECASTING;FUEL GAS: T2; GAS TURBINES: T4;PARTICLE SIZE;PARTICLES;PURIFICATION: Q1,Q2; REMOVAL;RENE 41;STAINLESS STEEL-304;VELOCITY

G-65
ACCESSION NO. 80C0004664
REPORT NO.PAGE CONF-791014 PP. V.34-V.39
TITLE MATERIALS AND PROCESS DEVELOPMENT FOR THE WATER-COOLED GAS TURBINE HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM
AUTHORS SCHILLING, W.F.
AUTHOR AFF GENERAL ELECTRIC CO., SCHENECTADY, NY
TITLE(MONO) FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO V.34-V.39
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE 4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE GAITHERSBURG, MD, USA
CONF DATE 9 OCT 1979
DATE 1979
CATEGORIES EDB-200104;360105
PRIMARY CAT EDB-200104
REPORT NO CONF-791014--
ABSTRACT NONE
DESCRIPTORS COOLING: Q1;CORROSION RESISTANCE: Q1;GAS TURBINES: T1; MATERIALS: Q1;NOZZLES

G-66
ACCESSION NO. 80C0004660
REPORT NO.PAGE CONF-791014 PP. II.58-II.62
TITLE EVALUATION OF HOT CORROSION RESISTANCE OF CANDIDATE CERAMIC COATINGS FOR INDUSTRIAL/UTILITY GAS TURBINES
AUTHORS BARKALOW, R.H.; PETTIT, F.S.
AUTHOR AFF PRATT AND WHITNEY AIRCRAFT, MIDDLETOWN, CN
TITLE(MONO) FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO II.58-II.62
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE 4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE GAITHERSBURG, MD, USA
CONF DATE 9 OCT 1979
DATE 1979
CATEGORIES EDB-200104;360205
PRIMARY CAT EDB-200104
REPORT NO CONF-791014--
ABSTRACT NONE
DESCRIPTORS AIR;ALUMINIUM OXIDES;CERAMICS: T2;COATINGS: Q2;CORROSION RESISTANCE: Q1;EVALUATION;GAS TURBINES: T1;MATERIALS: Q1; SILICON OXIDES;SULFUR TRIOXIDE;YTTRIUM OXIDES;ZIRCONIUM OXIDES

G-67
ACCESSION NO. 80C0004659
REPORT NO.PAGE CONF-791014 PP. K.95-K.110
TITLE MATERIALS DEVELOPMENT FOR HEAT EXCHANGERS AND TURBINES
AUTHORS STRINGER, J.
AUTHOR AFF ELECTRIC POWER RESEARCH INST., PALO ALTO, CA
TITLE(MONO) FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO K.95-K.110
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE 4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE GAITHERSBURG, MD, USA
CONF DATE 9 OCT 1979
DATE 1979
CATEGORIES EDB-200104;421000;014000
PRIMARY CAT EDB-200104
REPORT NO CONF-791014--
ABSTRACT IT IS CLEAR THAT THE USE OF HEAT EXCHANGERS AND GAS TURBINES WITH DIRECT COAL COMBUSTION PRESENTS A NUMBER OF PROBLEMS. A NUMBER OF CORROSIVE SITUATIONS CAN ARISE, ESSENTIALLY OF TWO TYPES. THE FIRST IS THE HIGH-TEMPERATURE CORROSION INDUCED BY MOLTEN SALT LAYERS RICH IN ALKALI METAL SULFATES IN THE PRESENCE OF RELATIVELY HIGH SO$SUB 3$ PARTIAL PRESSURES. THIS PRODUCES ACID FLUXING OF THE NORMALLY PROTECTIVE OXIDE, AND SEVERAL MECHANISMS EXIST WHICH RESULT IN THE DISSOLVED METAL BEING REPRECIPITATED AS A LOOSE, POROUS, NONPROTECTIVE OXIDE IN

THE OUTER PARTS OF THE MOLTEN SALT LAYER. THE SECOND FORM OF CORROSION IS SULFIDATION/OXIDATION, WHICH OCCURS WHEN THE OXYGEN ACTIVITY IS LOW IN THE PRESENCE OF A SULFUR SOURCE SUCH AS FES OR CASO$SUB 4$. BECAUSE COAL CONTAINS ASH, THE COMBUSTION PRODUCTS CONTAIN PARTICULATES, AND THESE CAN RESULT IN EROSION OF METALLIC COMPONENTS. THE REMEDIES ARE TO REMOVE THE PARTICLES, REDUCE THE GAS VELOCITY, OR IMPROVE THE MATERIALS. WHILE THE SELECTION AND DESIGN OF MATERIALS RESISTANT TO THE EROSIVE AND CORROSIVE ENVIRONMENTS IS PLAINLY VERY IMPORTANT, MANY OF THE PROBLEMS CAN BE REDUCED OR ELIMINATED BY APPROPRIATE CHANGES IN DESIGN OR OPERATIONAL PROCEDURE. IT IS IMPORTANT TO CONCENTRATE THE MATERIAL RESEARCH IN AREAS WHERE NO ALTERNATIVE FIX IS AVAILABLE, OR WHERE IT WOULD BE UNACCEPTABLE ON ECONOMIC OR PRACTICAL GROUNDS. IMPROVED MATERIALS MAY, HOWEVER, NOT ELIMINATE THE NEED FOR A DESIGN OR OPERATIONAL CHANGE, BUT THEY MAY MAKE IT EASIER TO ATTAIN AT A REASONABLE COST. THE INTERACTION OF THE MATERIALS PROBLEMS WITH THE SYSTEM CHARACTERISTICS MUST ALWAYS BE BORNE IN MIND.

DESCRIPTORS: ALKALI METAL COMPOUNDS;CLOSED-CYCLE SYSTEMS;COAL: T4;CORROSION; CYCLONE SEPARATORS;EROSION: Q5;FLUIDIZED-BED COMBUSTION: Q4; FLUIDIZED-BED COMBUSTORS: T6;FOSSIL-FUEL POWER PLANTS: T1;GAS TURBINES: T3,Q1;HEAT EXCHANGERS: T2,Q1;HOT GAS CLEANUP; MATERIALS: Q2,Q3;OXIDATION: Q6;PARTICLES;REMOVAL;SULFATES; SULFIDATION: Q6;TURBINE BLADES: T5;WORKING FLUIDS

G-68

ACCESSION NO.: 80R0004041
TITLE(MONO): 300 BTU GAS COMBUSTOR DEVELOPMENT PROGRAM. PHASE I. FINAL REPORT, AUGUST 1979
EDITOR OR COMP: BAILLIF, B.N.; BOENIG, F.H.; GRANT, J.R.; HOLLADAY, T.E.
CORPORATE AUTH: UNITED TECHNOLOGIES CORP., SOUTH WINDSOR, CT (USA). POWER SYSTEMS DIV.; PRATT AND WHITNEY AIRCRAFT GROUP, WEST PALM BEACH, FL (USA). GOVERNMENT PRODUCTS DIV.
PAGE NO: 100
AVAILABILITY: DEP. NTIS, PC A05/MF A01.
DATE: 1979
CATEGORIES: EDB-014000;200104
PRIMARY CAT: EDB-014000
REPORT NO: EPRI-AF--1144
ABSTRACT: INDUSTRIAL TURBINES FIRED ON MEDIUM HEATING VALUE (MHV) GAS (NOMINALLY 300 BTU/SCF) SYNTHESIZED FROM COAL OFFER AN ATTRACTIVE ALTERNATIVE MEANS OF PRODUCING ELECTRICAL POWER IN THE FUTURE. PEAK FLAME TEMPERATURES RESULTING FROM COMBUSTION OF THIS MHV GAS IN CONVENTIONAL DIFFUSION FLAME COMBUSTORS MAY BE COMPARABLE TO THOSE OF NATURAL GAS, YIELDING UNDESIRABLY HIGH CONCENTRATIONS OF NO/SUB X/. THE PURPOSE OF THIS PROGRAM WAS TO DEMONSTRATE A MHV GAS TURBINE COMBUSTOR CAPABLE OF MEETING ENVIRONMENTAL PROTECTION AGENCY (EPA) NO/SUB X/ REQUIREMENTS WITHOUT WATER INJECTION. PROGRAM OBJECTIVES WERE TO DESIGN, FABRICATE, AND TEST THREE MHV COMBUSTOR CONFIGURATIONS AND TO DEMONSTRATE NO/SUB X/ EMISSIONS CONCENTRATIONS OF 15 PPMV (DRY BASIS) OR LESS AT A BURNER INLET PRESSURE OF 1.27 ATMS. THE PROGRAM GOAL OF 15 PPMV CORRESPONDS TO APPROXIMATELY 55 PPMV AT ENGINE PRESSURES. CURRENT EPA REQUIREMENTS ARE 75 PPMV. DESIGN OF THE COMBUSTORS WAS BASED ON A LEAN-PREMIX CONCEPT. BY PREMIXING FUEL AND AIR IN LEAN PROPORTIONS PRIOR TO COMBUSTION, FLAME TEMPERATURES, AND THUS NO/SUB X/ FORMATION, WERE CONTROLLED. TESTS WERE CONDUCTED IN A SINGLE-CAN COMBUSTOR RIG AT SIMULATED ENGINE CONDITIONS RANGING FROM 40 TO 125% OF ENGINE BASELOAD (74 MW). MEASURED DATA INCLUDED INLET AND EXIT TEMPERATURES, PRESSURES, AND EMISSIONS OF NO/SUB X/, CO, CO$SUB 2$, O$SUB 2$ AND TOTAL (UNBURNED) HYDROCARBONS. A CONVENTIONAL DIFFUSION FLAME BURNER FIRED ON NATURAL GAS WAS ALSO TESTED TO OBTAIN BASELINE DATA. NO/SUB X/ DATA WERE CORRECTED TO STANDARD CONDITIONS AS PER EPA REQUIREMENTS FOR INLET PRESSURE, PERCENT O$SUB 2$, AND SPECIFIC HUMIDITY. RIG DATA WERE ANALYZED TO OBTAIN PERFORMANCE PARAMETERS OF COMBUSTION EFFICIENCY, BURNER PRESSURE LOSS, AND EXIT TEMPERATURE PATTERN FACTOR. RESULTS SHOW THAT ALL THREE COMBUSTORS MEET THE NO/SUB X/ GOAL, WITH CORRECTED CONCENTRATIONS OF 12 PPMV OR LESS OVER THE RANGE OF TEST CONDITIONS.
DESCRIPTORS: AIR POLLUTION CONTROL: D;BURNERS: T4;CHEMICAL REACTION YIELD: Q2,D;COAL GASIFICATION;COMBUSTION: Q1,D;COMBUSTORS;DESIGN: Q4; ELECTRIC UTILITIES: T3;EXPERIMENTAL DATA: D;GAS TURBINES: Q3; GRAPHS: D;INTERMEDIATE BTU GAS: T1,D;NITROGEN OXIDES: T2,D; TABLES: D

G-69

ACCESSION NO.: 80C0004040
REPORT NO.PAGE: CONF-791014 PP. V.26-V.27
TITLE: TASK 3: GAS TURBINE TECHNOLOGY OF THE COAL FIRED COMBINED CYCLE DEVELOPMENT PROGRAM
AUTHORS: BELTRAN, A.M.; GREY, D.A.
AUTHOR AFF: GENERAL ELECTRIC CO., SCHENECTADY, NY
TITLE(MONO): FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO: V.26-V.27
AVAILABILITY: DEP. NTIS, PC A99/MF A01.
CONF TITLE: 4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE: GAITHERSBURG, MD, USA
CONF DATE: 9 OCT 1979
DATE: 1979
CATEGORIES: EDB-014000;200104
PRIMARY CAT: EDB-014000
REPORT NO: CONF-791014--

ABSTRACT NONE
DESCRIPTORS CLADDING;COAL;COATINGS;COMBINED-CYCLE POWER PLANTS;COMBUSTION PRODUCTS: T2,Q1;CORROSION RESISTANCE: Q3;CORROSIVE EFFECTS: Q2; FLUIDIZED-BED COMBUSTION: T1;GAS TURBINES: T3

G-70

ACCESSION NO.	80C0004039
REPORT NO.PAGE	CONF-791014 PP. 32-60
TITLE	MATERIAL DESIGN REQUIREMENTS FOR COAL COMBUSTION
AUTHORS	SIMS, C.T.
AUTHOR AFF	GENERAL ELECTRIC CO., SCHENECTADY, NY
TITLE(MONO)	FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	32-60
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	9 OCT 1979
DATE	1979
CATEGORIES	EDB-014000;360105
PRIMARY CAT	EDB-014000
REPORT NO	CONF-791014--
ABSTRACT	COAL-DERIVED FUELS, INCLUDING DIRECTLY COMBUSTED COAL, COAL-DERIVED LIQUIDS, AND COAL-DERIVED GASES POSSESS POTENTIAL TO CAUSE DAMAGE TO GAS TURBINE HOT STAGE PARTS AND TO HEAT EXCHANGERS IN CONTACT WITH THE FUEL COMBUSTION PRODUCTS. PROPER PRODUCTION AND EFFECTIVE CLEANING OF THE FUELS AND GAS STREAMS IS MANDATORY TO PRECLUDE OCCURRENCE OF CORROSION, EROSION AND FOULING. ADVANCED AIR-COOLED TURBINE DESIGNS AND WATER-COOLED DESIGNS AS WELL AS HEAT EXCHANGERS REQUIRE COOLED MATERIALS TO OPERATE IN GAS STREAMS AT HIGHER TEMPERATURES THAN EVER, CREATING SHARP THERMAL GRADIENTS. THESE CAN GENERATE A SIGNIFICANT MATERIALS PROBLEM. FUEL SPECIFICATIONS EXISTING FOR GASES AND PETROLEUM-BASED FUELS, WHILE HELPFUL AS GUIDES FOR COAL AND COAL-DERIVED FUELS, ULTIMATELY WILL REQUIRE REVISION. FOR EXAMPLE, NA AND K CAN NO LONGER BE CONSIDERED EQUIVALENT WITH RESPECT TO CORROSION DAMAGE. REDUCED AVAILABILITY AND INCREASED COST OF THE NONFERROUS ELEMENT UTILIZED IN HIGH-PERFORMANCE ALLOY' WILL BE INTERMITTENT NAGGING PROBLEMS; WORK IS ESSENTIAL TO DEVELOP ALLOYS WITH LESS STRATEGIC ELEMENT CONTENT. PRODUCTIVE BASIC AND APPLIED RESEARCH INVOLVING THE UNIVERSITY-TYPE ATMOSPHERE WITH INTEGRATION/LEADERSHIP BY INDUSTRY IS NEEDED IN THE FOLLOWING AREAS: IMPROVED ALLOY PROTECTION, ACTIVITY TO UNDERSTAND DETAILS OF ADVANCED PROCESSING, GREATER STRENGTH AND FATIGUE BEHAVIOR, DEVELOPMENTS OF COMPOSITE SUPERALLOYS STRUCTURES, DEVELOPMENT OF CORROSION - RESISTANT TBC'S, AND WELDABLE/JOINABLE HEAT EXCHANGER ALLOYS WITH GREATER CREEP RESISTANCE.
DESCRIPTORS	AVAILABILITY;CHROMIUM;CLADDING;COAL: T1;COAL GASIFICATION;COAL LIQUEFACTION;COAL LIQUIDS: T3;COMBINED-CYCLE POWER PLANTS; COMBUSTION: Q1,Q2,Q3;CORROSION;CORROSION RESISTANT ALLOYS; DESIGN: Q4,Q5;EROSION;FLUIDIZED-BED COMBUSTION: Q1;FOULING;FUEL GAS: T2;GAS TURBINES: T4;HEAT EXCHANGERS: T5;MATERIALS: Q4,Q5; MHD GENERATORS;MOLYBDENUM;OXIDATION;POTASSIUM COMPOUNDS;PRICES; PROTECTIVE COATINGS;RESEARCH PROGRAMS;SPECIFICATIONS;STANDARDS; TANTALUM;TEMPERATURE GRADIENTS

G-71

ACCESSION NO.	80C0003878
REPORT NO.PAGE	CONF-791014 PP. II.17-II.21
TITLE	CORROSION AND MECHANICAL BEHAVIOR OF MATERIALS FOR APPLICATION IN COAL CONVERSION AND UTILIZATION
AUTHORS	NATESAN, K.
AUTHOR AFF	ARGONNE NATIONAL LAB., IL
TITLE(MONO)	FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	II.17-II.21
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	9 OCT 1979
DATE	1979
CATEGORIES	EDB-010404;360105;360103
PRIMARY CAT	EDB-010404
REPORT NO	CONF-791014--
ABSTRACT	NONE
DESCRIPTORS	CHEMICAL COMPOSITION;COAL GASIFICATION PLANTS: T1;CORROSION: Q1; CORROSIVE EFFECTS;GAS TURBINES: T3;HEAT EXCHANGERS: T2;INCOLOY 800;INCONEL 671;IRON BASE ALLOYS;MATERIALS: Q2,Q3;NICKEL BASE ALLOYS;OXIDATION;PHASE STUDIES;PROTECTIVE COATINGS;STABILITY; STAINLESS STEEL-310: T4;SULFIDATION;TEMPERATURE DEPENDENCE; TENSILE PROPERTIES: Q4

G-72

ACCESSION NO.	80C0003870
TITLE(MONO)	FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CORPORATE AUTH	DEPARTMENT OF ENERGY, WASHINGTON, DC (USA). DIV. OF PLANNING AND SYSTEMS ENGINEERING
PAGE NO	678
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	4. ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	9 OCT 1979
DATE	1979
CATEGORIES	EDB-010404;010405;421000;360000
PRIMARY CAT	EDB-010404
REPORT NO	CONF-791014--
ABSTRACT	THE FOURTH ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION WAS HELD OCTOBER 9 TO 11, 1979, AT THE NATIONAL BUREAU OF STANDARDS, GAITHERSBURG, MARYLAND. IT WAS SPONSORED

	BY THE NATIONAL BUREAU OF STANDARDS, THE ELECTRIC POWER RESEARCH INSTITUTE, THE US DEPARTMENT OF ENERGY, AND THE GAS RESEARCH INSTITUTE. THE PAPERS HAVE BEEN ENTERED INDIVIDUALLY INTO EDB AND ERA. (LTN)
DESCRIPTORS	COAL;COAL GASIFICATION PLANTS: T1;COAL LIQUEFACTION PLANTS: T2;COATINGS;COMBUSTION;CORROSION;EROSION;FLUIDIZED-BED COMBUSTORS: T3;GAS TURBINES: T4;HEAT EXCHANGERS;HYDROGEN;MATERIALS: T5,Q1,Q2,Q3,Q4;MEETINGS: Q1,Q2,Q3,Q4,Q5;METALLURGICAL EFFECTS;MHD GENERATORS;PRESSURE VESSELS;REFRACTORIES;STAINLESS STEELS;STEELS;SULFIDATION

G-73

ACCESSION NO.	80R0000823
TITLE(MONO)	SUMMARY OF THE RESEARCH AND DEVELOPMENT EFFORT ON OPEN-CYCLE COAL-FIRED GAS TURBINES
EDITOR OR COMP	LACKEY, M.E.
CORPORATE AUTH	OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO	126
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-26
DATE	OCT 1979
CATEGORIES	EDB-200104;014000
PRIMARY CAT	EDB-200104
REPORT NO	ORNL/TM--6253
ABSTRACT	EXTENSIVE EXPERIENCE GAINED WITH GAS TURBINES OPERATING NOT ONLY WITH COAL AS FUEL BUT ALSO WITH DUSTY INLET AIR AND WITH DIRTY FUELS (SUCH AS HEAVY OILS AND BLAST FURNACE GAS) AS WELL AS PETROLEUM CATALYTIC CRACKING UNITS WAS REVIEWED. ALL THIS EXPERIENCE INDICATES THAT THE PARTICULATE CONTENT OF THE HOT GASES FED TO THE TURBINE MUST BE KEPT TO LESS THAN APPROX. 1 PPM TO KEEP TURBINE BUCKET EROSION TO AN ACCEPTABLE LEVEL FOR TURBINE INLET TEMPERATURES OF 1500$SUP 0$F OR MORE. DROPPING THE TURBINE INLET TEMPERATURE BELOW 1110$SUP 0$F MAKES IT POSSIBLE TO OBTAIN TURBINE BUCKET LIVES OF AROUND 3 YR WITH APPROX. 100 PPM OF PARTICULATES IF A NUMBER OF COMPROMISES ARE MADE IN THE TURBINE DESIGN. A BUILDUP OF DEPOSITS IN THE TURBINE IS A SERIOUS PROBLEM IF SULFATES OR CHLORIDES ARE PRESENT IN THE GAS STREAM AND THE TURBINE INLET TEMPERATURE IS ABOVE APPROX. 1110$SUP 0$F. AT THIS TEMPERATURE LEVEL, THESE MATERIALS BECOME SOFT AND STICKY AND FORM FILMS ON THE BLADES THAT ACCUMULATE DEPOSITS OF THE SILICATES AND OXIDES PRESENT IN THE ASH OF A COAL-FIRED COMBUSTOR. EXTENSIVE EXPERIENCE WITH MANY TYPES OF CYCLONE SEPARATORS SHOWS THAT THEY CAN BE USED TO REDUCE THE PARTICULATE CONTENT TO AS LOW AS APPROX. 100 PPM UNDER THE BEST CONDITIONS. GRANULAR BED FILTERS HAVE YIELDED SIMILAR PERFORMANCE. ELECTROSTATIC PRECIPITATORS ARE NOT EFFECTIVE ABOVE APPROX. 1110$SUP 0$F BECAUSE THE DUST DEPOSITS ON INSULATORS BECOME CONDUCTING AND SHORT OUT THE GRIDS. THE ONLY EFFECTIVE WAY FOUND TO REDUCE THE PARTICULATE CONTENT OF BLAST FURNACE GAS AND GAS FROM COAL GASIFICATION UNITS TO THE APPROX. 1 PPM REQUIRED FOR A HIGH-TEMPERATURE GAS TURBINE IS TO COOL THE GAS AND PASS IT THROUGH A TWO-STAGE WATER SCRUBBER OR EQUIVALENT BEFORE BURNING IT. IN BRIEF, IT APPEARS DOUBTFUL THAT ANY OF THE HOT-GAS CLEAN-UP CONCEPTS BEING INVESTIGATED WILL YIELD THE LOW PARTICULATE CONTENTS REQUIRED FOR THE SATISFACTORY, ECONOMICAL OPERATION OF 1500 TO 1600$SUP 0$F LONG-LIVED GAS TURBINES.
DESCRIPTORS	COAL: T3;COAL GASIFICATION PLANTS: T2;COMBUSTION PRODUCTS;CORROSION;CYCLONE SEPARATORS;ECONOMICS;ELECTROSTATIC PRECIPITATORS;ENERGY CONVERSION;EROSION: Q1;FLUIDIZED-BED COMBUSTION: Q3;GAS TURBINES: T1;HOT GAS CLEANUP: Q2;OPERATION: Q1;PARTICLES;PERFORMANCE;RESEARCH PROGRAMS: Q1;SCRUBBERS;TEMPERATURE DEPENDENCE

G-74

ACCESSION NO.	79J0137949
TITLE	EFFECT OF ENVIRONMENTAL REGULATIONS ON THE GENERAL ELECTRIC RESEARCH AND DEVELOPMENT PROGRAM FOR COMBUSTION TURBINES USING COAL-DERIVED FUELS
AUTHORS	DIBELIUS, N.R.; KETTERER, R.J.; MANNING, G.B.
AUTHOR AFF	GE, SCHENECTADY, NY
PUB DESC	AM. SOC. MECH. ENG., _PAP.*, NO. 79-GT-41, PP. 1-9
DATE	1979
CATEGORIES	EDB-500600;520600;014000
PRIMARY CAT	EDB-500600
ABSTRACT	THIS PAPER DISCUSSES THE CLEAN AIR ACT, THE CLEAN WATER ACT, AND NOISE CONTROL ACT AS THEY AFFECT STATIONARY COMBUSTION TURBINES, INCLUDING COMBUSTION TURBINES ON COAL-DERIVED LIQUID AND GASEOUS FUELS. IT ALSO INCLUDES A DISCUSSION OF REGULATIONS RESULTING FROM THESE ACTS INSOFAR AS THEY EXISTED AS OF JULY, 1978. NEW REGULATIONS ARE BEING ADDED PERIODICALLY. THIS SITUATION WILL CONTINUE AND THEREFORE REQUIRES THAT THE MOST RECENT REGULATIONS BE CONSULTED FOR ANY GIVEN CASE.
DESCRIPTORS	CLEAN AIR ACT;COAL LIQUIDS: T2;COMBUSTION: Q2;ENVIRONMENTAL EFFECTS: Q1;ENVIRONMENTAL POLICY;GAS TURBINES: T1;POLLUTION LAWS: T,Q1;REGULATIONS;RESEARCH PROGRAMS

G-75

ACCESSION NO.	79P0137575
PATENT NO	GERMAN(FRG) PATENT 2,754,805/A/
TITLE(MONO)	METHOD AND DEVICE TO REPAIR FAULTS IN GAS TURBINE BLADES
EDITOR OR COMP	PAILLE, W.A.
PAT ASSIGNEE	TO GENERAL ELECTRIC CO., SCHENECTADY, NY (USA); DEUTSCHES PATENTAMT, MUENCHEN (GERMANY, F.R.)
PAGE NO	18
DATE	15 JUN 1978
LANGUAGE	IN GERMAN
CATEGORIES	EDB-420200
PRIMARY CAT	EDB-420200
AUGMENTATION	PATENT
ABSTRACT	TO REPAIR AND PREVENT DEFECTS IN TURBINE BLADES (TITANIUM ALLOY A CREEP MOLDING TECHNIQUE IS USED. IT IS A COMBINATION OF INDIVIDUAL MOLDING SYSTEM AND CENTRIFUGAL FORCE STRESS. THE

BLADES AND RECESSES OF THE INDIVIDUAL MOLDS ARE DYNAMICALLY BALANCED ON A ROTOR. FOR THIS PURPOSE, THE ROTOR IS TRANSFERRED INTO A HEATED CHAMBER WITH A NEUTRAL ATMOSPHERE AND ROTATED. SPEED, TEMPERATURE AND LENGTH OF TREATMENT ARE A FUNCTION OF THE BLADE MATERIAL, THE CONFIGURATION AND THE DEFECT PERCENTAGE.

DESCRIPTORS: DYNAMIC LOADS;FABRICATION;FAILURES: Q1;GAS TURBINES;MATERIALS; REPAIR: Q1;ROTORS;TEMPERATURE DEPENDENCE;TURBINE BLADES: M1

G-76

ACCESSION NO.	79C0136250
REPORT NO.PAGE	DOE/EV--0046(VOL.1 PP. 177-198
TITLE	LOW NO/SUB X/ HEAVY FUEL COMBUSTOR CONCEPT PROGRAM
AUTHORS	FACEY, J.R.); NIEDZWIECKI, R.W.
AUTHOR AFF	DEPT. OF ENERGY, WASHINGTON, D
TITLE(MONO)	PROCEEDINGS OF THE US DEPARTMENT OF ENERGY ENVIRONMENTAL CONTROL SYMPOSIUM. VOLUME 1. PLENARY SESSION AND FOSSIL FUELS
SEC REPT NO	CONF-781109--(VOL.1)
PAGE NO	177-198
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	ENVIRONMENTAL CONTROL SYMPOSIUM
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	28 NOV 1978
DATE	SEP 1979
CATEGORIES	EDB-200202;025000
PRIMARY CAT	EDB-200202
REPORT NO	DOE/EV--0046(VOL.1)
ABSTRACT	THE OBJECTIVES OF THIS PROGRAM ARE TO GENERATE AND DEMONSTRATE THE TECHNOLOGY REQUIRED TO DEVELOP DURABLE GAS TURBINE COMBUSTORS FOR UTILITY AND INDUSTRIAL APPLICATIONS, WHICH ARE CAPABLE OF SUSTAINED, ENVIRONMENTALLY ACCEPTABLE OPERATION WITH MINIMALLY PROCESSED PETROLEUM RESIDUAL FUELS. THE PROGRAM WILL FOCUS ON DRY REDUCTIONS OF OXIDES OF NITROGEN (NO/SUB X/) AND IMPROVED COMBUSTOR DURABILITY WHILE USING MINIMALLY PROCESSED PETROLEUM RESIDUAL FUELS. OTHER TECHNOLOGY ADVANCEMENTS SOUGHT INCLUDE: FUEL FLEXIBILITY FOR OPERATION WITH PETROLEUM DISTILLATES, BLENDS OF PETROLEUM DISTILLATES AND RESIDUAL FUELS, AND SYNFUELS (FUEL OILS DERIVED FROM COAL OR SHALE); ACCEPTABLE EXHAUST EMISSIONS OF CARBON MONOXIDE, UNBURNED HYDROCARBONS, SULFUR OXIDES AND SMOKE; AND RETROFIT CAPABILITY TO EXISTING ENGINES.
DESCRIPTORS	AIR POLLUTION CONTROL: Q2,Q3,Q4,Q5,Q6;CARBON;CARBON MONOXIDE: T3;COMBUSTION: Q1;COMBUSTORS: T7;CORROSION;DEPOSITION;DESIGN: Q7;GAS TURBINES;HYDROCARBONS: T4;NITROGEN OXIDES: T2;RESIDUAL FUELS: T1;SMOKES: T6;SULFUR OXIDES: T5

G-77

ACCESSION NO.	79J0136243
TITLE	PLATE HEAT EXCHANGERS IN ALASKA SAVE $4 MILLION PER YEAR
PUB DESC	CHEM. PROCESS. (CHICAGO), V. 42, NO. 4, P. 32
DATE	APR 1979
CATEGORIES	EDB-200105
PRIMARY CAT	EDB-200105
ABSTRACT	TWENTY-FOUR BANKS OF INFLATED-TYPE PLATE HEAT EXCHANGERS PLAY A KEY ROLE IN THE ENERGY CONSERVATION PROGRAM AT THE ELECTRICAL GENERATING FACILITY IN THE CITY OF ANCHORAGE, ALASKA. THE EXCHANGERS RECOVER 138 MILLION BTU OF HEAT/HR. FIRST SUBSTANTIAL SAVINGS IS PROVIDED BY THE USE OF HOT EXHAUST GAS, 1000$SUP 0$F, FROM NATURAL GAS-FIRED TURBINES TO FURNISH STEAM FOR THE TURBINES. THIS RESULTS IN GENERATION OF 33% MORE ELECTRICITY WITHOUT ADDITIONAL FUEL. AT THIS POINT THE SECOND ENERGY CONSERVATION FACTOR IN WHICH THE PLATE-TYPE HEAT EXCHANGERS ARE USED COMES INTO PLAY. WATER AT 108$SUP 0$F FROM THE STEAM TURBINE FLOWS ON THE OUTSIDE OF THE PLATE EXCHANGERS AT A RATE OF 23,000 GPM. THIS 108$SUP 0$F WATER WARMS 7200 GPM OF MUNICIPAL WATER FLOWING THROUGH INTERIOR OF EXCHANGERS WHICH PREVENTS FREEZING. ANCHORAGE OFFICIALS ESTIMATE THAT ANNUAL SAVINGS COULD EXCEED $4 MILLION PER YEAR BY ELIMINATING THE COST OF PIPE THAWING AND FREEZE PREVENTION, ALONG WITH DECREASED WATER CONSUMPTION.
DESCRIPTORS	ALASKA;ECONOMICS: Q4;GAS TURBINES: Q1;HEAT RECOVERY EQUIPMENT: T2,Q1;HEATING;OPERATION: Q2;THERMAL POWER PLANTS: T1;WASTE HEAT; WASTE HEAT UTILIZATION: T4;WATER

G-78

ACCESSION NO.	79R0136226
TITLE(MONO)	SCREENING EVALUATION OF ELECTRIC POWER CYCLES INTEGRATED WITH COAL GASIFICATION PLANTS
EDITOR OR COMP	GALLAGHER, S.P.; AHNER, D.J.
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA)
PAGE NO	80
AVAILABILITY	DEP. NTIS, PC A05/MF A01.
DATE	SEP 1979
CATEGORIES	EDB-200102;010404
PRIMARY CAT	EDB-200102
AUGMENTATION	STEAM-BOTTOMED VS NON-STEAM-BOTTOMED CYCLES
REPORT NO	EPRI-AF--1160
ABSTRACT	POTENTIALLY LOWER COST ALTERNATIVES TO PRESENT CONCEPTS FOR

INTEGRATED GASIFICATION COMBINED CYCLE POWER PLANTS HAVE BEEN INVESTIGATED. THE STUDY WAS INITIATED BASED ON ESTIMATES WHICH SHOWED THAT STEAM-BOTTOMING EQUIPMENT WOULD AMOUNT TO 25 OR 30% OF THE TOTAL CAPITAL COST OF AN INTEGRATED GASIFICATION COMBINED CYCLE POWER PLANT. THE CAPITAL SAVING OF REMOVING THE STEAM SYSTEM WAS OBVIOUS. THE QUESTION REMAINED WHETHER THE EFFICIENCY OF A LOWER COST ALTERNATIVE COULD BE HIGH ENOUGH TO MAKE THE SYSTEM ATTRACTIVE. CONSEQUENTLY, A RELATIVELY SIMPLE, POTENTIALLY LOW COST, NON STEAM-BOTTOMED CYCLE WAS EVOLVED AND THE SYSTEM THERMAL EFFICIENCY CALCULATED. THERMAL EFFICIENCIES WERE ALSO DETERMINED FOR SEVERAL STEAM-BOTTOMED CYCLES. THE NON STEAM-BOTTOMED CYCLE WAS FOUND TO HAVE A THERMAL EFFICIENCY OF 32%. HOWEVER, ATTAINMENT OF THIS PERFORMANCE LEVEL DEPENDS ON DEVELOPMENT OF HOT PARTICULATE REMOVAL EQUIPMENT AND HIGH PERFORMANCE LEVEL DEPENDS ON DEVELOPMENT OF HOT PARTICULATE REMOVAL EQUIPMENT AND HIGH PERFORMANCE EXPANDER TURBINES BEYOND THE CURRENT STATE-OF-THE-ART. THE STEAM-BOTTOMED CYCLES ANALYZED IN THE STUDY SHOWED EFFICIENCY ESTIMATES BETWEEN 38.8 AND 40.3%, SUBSTANTIALLY HIGHER THAN THE NON STEAM-BOTTOMED CASE. HIGH PERFORMANCE FUEL GAS EXPANDER TURBINES AND THEIR ASSOCIATED HOT PARTICULATE REMOVAL AND HEAT EXCHANGE EQUIPMENT WERE FOUND TO BE THE MOST DEVELOPMENTAL, HIGHEST RISK ITEMS CONSIDERED IN THE STUDY. IT WAS ALSO NOTED THAT IF SUCH EQUIPMENT WAS DEVELOPED, IT COULD BE APPLIED TO BOTH STEAM-BOTTOMED AND NON STEAM-BOTTOMED CYCLES. THE EFFICIENCY FOR AN INTEGRATED GASIFICATION COMBINED CYCLE USING GAS TURBINES AT CURRENT FIRING TEMPERATURES WAS ESTIMATED AT 37.7%. PERFORMANCE AT THIS LEVEL SUGGESTS THE POSSIBILITY THAT INTEGRATED GASIFICATION COMBINED CYCLES USING CURRENT GAS TURBINES MAY BE ATTRACTIVE FOR NEAR-TERM APPLICATION.

DESCRIPTORS: BOTTOMING CYCLES;COAL GASIFICATION: T;COMBINED-CYCLE POWER PLANTS: M1;COMPARATIVE EVALUATIONS: Q1;DESIGN;ECONOMICS; ENGINEERING;EQUIPMENT;FLOWSHEETS;GAS TURBINES;HEAT EXCHANGERS; HOT GAS CLEANUP;STEAM TURBINES;TEXACO GASIFICATION PROCESS; THERMAL EFFICIENCY;TOPPING CYCLES;WATER REQUIREMENTS

G-79

ACCESSION NO.: 79R0136219
TITLE(MONO): ADVANCED COAL-FUELED COMBUSTOR/HEAT EXCHANGER TECHNOLOGY STUDY. FINAL REPORT, MARCH 1977-JUNE 1978
CORPORATE AUTH: ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA (USA). ROCKETDYNE DIV.
PAGE NO: 418
AVAILABILITY: DEP. NTIS, PC A18/MF A01.
CONTRACT NO: CONTRACT EF-77-C-01-2612
DATE: 1978
CATEGORIES: EDB-200101;200104
PRIMARY CAT: EDB-200101
REPORT NO: RI/RD--78-2128
ABSTRACT: THE DESIGN OF COAL-FIRED COMBUSTOR/HEAT EXCHANGERS SUITABLE FOR INPUTING THE HEAT TO BASE-LOADED, CLOSED-CYCLE, GAS TURBINE, 350 MWE, CENTRAL STATION POWER GENERATION SYSTEMS IS DISCUSSED. A WIDE VARIETY OF CCGT CYCLES ARE EVALUATED TO ESTABLISH THE PERFORMANCE REQUIREMENTS FOR THE COMBUSTOR/HEAT EXCHANGER. THE CYCLES FINALLY SELECTED FOR COMBUSTOR/HEAT EXCHANGER DESIGN OPERATE AT 1550 F, 1750 F, AND 2250 F MAXIMUM WORKING-FLUID TEMPERATURES. EACH SELECTED CYCLE IS BOTTOMED WITH A RANKINE/STEAM CYCLE OPERATING AT 2400 PSI/1050 F/1050 F. THE COAL INPUTS TO STATIONS INCORPORATING THE SELECTED CYCLES ARE ESTIMATED TO RANGE FROM 82 TO 88% OF THE REQUIRED INPUT TO A 2400-PSI/1000 F/1000 F CONVENTIONAL STEAM STATION. AT THE 1550 F MAXIMUM WORKING-FLUID TEMPERATURE, TWO COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGNS ARE CREATED, ONE UTILIZING THE PULVERIZED-COAL-FIRED, DRY-BOTTOM FURNACE FIRING CONCEPT AND THE OTHER UTILIZING THE ATMOSPHERIC-PRESSURE, FLUIDIZED BED WITH LIMESTONE ADDITION FIRING CONCEPT. AT THE 1750 F MAXIMUM WORKING-FLUID TEMPERATURE, THE COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGN IS BASED ON A SERIES ARRANGEMENT OF HIGH- AND LOW-TEMPERATURE FLUIDIZED BEDS. AT 2250 F MAXIMUM WORKING-FLUID TEMPERATURE, THE COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGN IS BASED ON THE SLAGGING CYCLONE COMBUSTOR CONCEPT. HEAT EXCHANGER SURFACE EXPOSED TO WORKING-FLUID TEMPERATURES ABOVE 1550 F IN THE LAST TWO DESIGNS IS CONSTRUCTED OF SILICON CARBIDE. THE KEY TECHNICAL FEATURES OF THE FOUR PRELIMINARY DESIGNS ARE IDENTIFIED AND ANALYZED. RESEARCH AND DEVELOPMENT PROGRAMS TO ADVANCE THE TECHNOLOGY OF THESE DESIGNS TO A STATE OF READINESS FOR COMMERCIAL APPLICATION ARE OUTLINED, AND R AND D COST ESTIMATES ARE PRESENTED. THE COST OF ELECTRICITY PRODUCED IN 700 MWE STATIONS INCORPORATING THE STUDIED CCGT CYCLES AND COMBUSTOR/HEAT EXCHANGERS IS ESTIMATED AND COMPARED WITH THE COST OF ELECTRICITY IN CONVENTIONAL STEAM STATIONS.
DESCRIPTORS: AIR POLLUTION CONTROL;COAL: T5;COMBINED-CYCLE POWER PLANTS: T1; COMBUSTORS: T4;COMMINUTION;CORROSION: D,Q2;COST: Q1,Q2,Q3,D; DESIGN: Q2,Q3,Q4;ELECTRIC POWER;FLUIDIZED-BED COMBUSTION: Q5; FLUIDIZED-BED COMBUSTORS: T2,Q1,D;GAS TURBINE POWER PLANTS;GAS TURBINES;GRAPHS: D;HEAT EXCHANGERS: T3,Q1,D;HIGH TEMPERATURE; NUMERICAL DATA: D;PERFORMANCE: Q2,Q3,Q4,D;POWER GENERATION; RESEARCH PROGRAMS;TABLES: D;VERY HIGH TEMPERATURE

G-80

ACCESSION NO.	79C0131229
REPORT NO.PAGE	CONF-781050 PP. 248-257
TITLE	CERAMIC REGENERATOR SYSTEM DEVELOPMENT PROGRAM
AUTHORS	RAHNKE, C.J.
AUTHOR AFF	FORD MOTOR CO., DEARBORN, MI
TITLE(MONO)	PROCEEDINGS OF HIGHWAY VEHICLE SYSTEMS. CONTRACTORS' COORDINATION MEETING: FIFTEENTH SUMMARY REPORT
PAGE NO	248-257
AVAILABILITY	DEP. NTIS, PC A25/MF A01.
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS' MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	17 OCT 1978
DATE	MAR 1979
CATEGORIES	EDB-330103;360201
PRIMARY CAT	EDB-330103
REPORT NO	CONF-781050--
ABSTRACT	DATA ACCUMULATED IN THE LAST SIX MONTHS CONTINUES TO SHOW THAT TWO MATERIALS, ALUMINUM SILICATE (AS) AND MAGNESIUM-ALUMINUM SILICATE (MAS), HAVE THE POTENTIAL OF ACHIEVING THE PROGRAM OBJECTIVE OF A B10 LIFE OF 10,000 H AT 800$SUP 0$C. TO DATE, NONE OF THE EIGHTEEN AS OR SIX MAS CORES THAT HAVE BEEN ENGINE TESTED SHOW ANY SERIOUS SIGNS OF CHEMICAL ATTACK DAMAGE. ONE THICK-WALL AS CORE HAS ACCUMULATED 10,600 H AND ANOTHER HAS OVER 9500 H OF ENGINE TEST. A THIN-WALL AS CORE HAS OVER 8000 H AND A MAS CORE HAS OVER 5000 H OF TEST AT 800$SUP 0$C. MORE EMPHASIS HAS BEEN PLACED ON 1000$SUP 0$C TESTS, AND FIVE AS AND ONE MAS CORE ARE NOW ON TEST AT THIS TEMPERATURE. A THICK-WALL AS CORE HAS NOW ACCUMULATED OVER 6000 H AT 1000$SUP 0$C. OTHER NEW MATERIALS ARE NOW UNDERGOING LABORATORY AND ENGINE SCREENING TESTS FOR CHEMICAL ATTACK RESISTANCE AND ELEVATED TEMPERATURE CAPABILITY.
DESCRIPTORS	ALUMINIUM SILICATES;AUTOMOBILES: T1;CERAMICS;GAS TURBINES: T2,01;MAGNESIUM SILICATES;REGENERATORS: 02;RESEARCH PROGRAMS

G-81

ACCESSION NO.	79C0131223
REPORT NO.PAGE	CONF-781050 P. 205
TITLE	AUTOMOTIVE GAS TURBINE CERAMIC MATERIALS PROGRAM OVERVIEW
AUTHORS	BLANKENSHIP, C.P.
AUTHOR AFF	LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO)	PROCEEDINGS OF HIGHWAY VEHICLE SYSTEMS. CONTRACTORS' COORDINATION MEETING: FIFTEENTH SUMMARY REPORT
PAGE NO	205
AVAILABILITY	DEP. NTIS, PC A25/MF A01.
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS' MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	17 OCT 1978
DATE	MAR 1979
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-781050--
ABSTRACT	THE BRIEF DESCRIPTION OF THE PROGRAM PRESENTED INDICATES THE FOCUS OF THE ACTIVITY, THE PROGRAM STRUCTURE, AND SOME OF THE CURRENT PROJECTS. ACCOMPLISHMENT OF THE PROGRAM WILL BE DONE PRIMARILY THROUGH GOVERNMENT CONTRACTS WITH INDUSTRY. THE OVERALL STRUCTURE OF THE PROGRAM IS SHOWN. THE PRIMARY INTERESTS OF THE PROGRAM IN THE CERAMIC MATERIAL AND COMPONENT AREAS ARE ALSO LISTED. A VERY BROAD OVERVIEW OF THE CERAMIC MATERIALS PROGRAM COVERS: (1) MATERIALS CHARACTERIZATION; (2) IMPROVED MATERIALS DEVELOPMENT; AND (3) COMPONENT DEVELOPMENT.
DESCRIPTORS	AUTOMOBILES: T1;CERAMICS: 02;GAS TURBINES: T2,01;RESEARCH PROGRAMS

G-82

ACCESSION NO.	79C0131222
REPORT NO.PAGE	CONF-781050 PP. 195-204
TITLE	COMPONENT CONSIDERATIONS FOR ADVANCED AUTOMOTIVE GAS TURBINES: OVERALL ENGINE ASPECTS
AUTHORS	WAGNER, C.E.
AUTHOR AFF	CHRYSLER CORP., DETROIT, MI
TITLE(MONO)	PROCEEDINGS OF HIGHWAY VEHICLE SYSTEMS. CONTRACTORS' COORDINATION MEETING: FIFTEENTH SUMMARY REPORT
PAGE NO	195-204
AVAILABILITY	DEP. NTIS, PC A25/MF A01.
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS' MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	17 OCT 1978
DATE	MAR 1979
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-781050--
ABSTRACT	CONSIDERING THE ENGINE AS A WHOLE, THREE AREAS PERTAINING TO IDENTIFICATION OF CRITICAL TECHNOLOGY ARE DISCUSSED: (1) SENSITIVITY OF FUEL ECONOMY TO COMPONENT EFFICIENCY, PARASITIC LOSSES, AND ENGINE ARRANGEMENT OR CONCEPT; (2) THROTTLE RESPONSE; AND (3) COST.
DESCRIPTORS	AUTOMOBILES: T1;COST;FUEL ECONOMY;GAS TURBINES: T2,01;RESEARCH PROGRAMS: 02

G-83

ACCESSION NO.	79C0131219
REPORT NO.PAGE	CONF-781050 PP. 176-185
TITLE	COMBUSTOR CONSIDERATIONS FOR ADVANCED AUTOMOTIVE GAS TURBINE ENGINES
AUTHORS	BARRETT, H.E.
AUTHOR AFF	DETROIT DIESEL ALLISON, MI
TITLE(MONO)	PROCEEDINGS OF HIGHWAY VEHICLE SYSTEMS. CONTRACTORS' COORDINATION MEETING: FIFTEENTH SUMMARY REPORT
PAGE NO	176-185
AVAILABILITY	DEP. NTIS, PC A25/MF A01.
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS' MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	17 OCT 1978
DATE	MAR 1979
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-781050--
ABSTRACT	THE OBJECTIVES OF THE IMPROVED GAS TURBINE PROGRAM INCLUDE: (1)

20% IMPROVEMENT (OVER 1976) IN POWERTRAIN THERMAL EFFICIENCY AND FUEL ECONOMY; (2) ENTER PRODUCTION ENGINEERING DEVELOPMENT IN 1983; (3) COMPETITIVE RELIABILITY AND LIFE; (4) ACCEPTABLE DRIVEABILITY; (5) MEET OR EXCEED FEDERAL EMISSIONS STANDARDS; (6) MEET NOISE AND SAFETY LEGISLATION; AND (7) COMPETITIVE INITIAL AND LIFE CYCLE COST. (TFD)

DESCRIPTORS — AIR POLLUTION ABATEMENT;COMBUSTORS;COST;FUEL ECONOMY;GAS TURBINES: T2,01;RESEARCH PROGRAMS: 02;VEHICLES: T1

G-84

ACCESSION NO. — 79R0131179
TITLE(MONO) — GAS TURBINES
EDITOR OR COMP — FARAHAN, E.; EUDALY, J.P.
CORPORATE AUTH — OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO — 100
AVAILABILITY — DEP. NTIS, PC A05/MF A01.
CONTRACT NO — CONTRACT W-31-109-ENG-38;W-7405-ENG-26
DATE — OCT 1976
CATEGORIES — EDB-320603;200104
PRIMARY CAT — EDB-320603
REPORT NO — ANL/CES/TE--78-8
ABSTRACT — THIS EVALUATION PROVIDES PERFORMANCE AND COST DATA FOR COMMERCIALLY AVAILABLE SIMPLE- AND REGENERATIVE-CYCLE GAS TURBINES. INTERCOOLED, REHEAT, AND COMPOUND CYCLES ARE DISCUSSED FROM THEORETICAL BASIS ONLY, BECAUSE ACTUAL UNITS ARE NOT CURRENTLY AVAILABLE, EXCEPT ON A SPECIAL-ORDER BASIS. PERFORMANCE CHARACTERISTICS INVESTIGATED INCLUDE UNIT EFFICIENCY AT FULL-LOAD AND OFF-DESIGN CONDITIONS, AND AT RATED CAPACITY. COSTS ARE TABULATED FOR BOTH SIMPLE- AND REGENERATIVE-CYCLE GAS TURBINES. THE OUTPUT CAPACITY OF THE GAS TURBINES INVESTIGATED RANGES FROM 60 TO 134,000 HP FOR SIMPLE UNITS AND FROM 12,000 TO 50,000 HP FOR REGENERATIVE UNITS.
DESCRIPTORS — COST: 01,D;DESIGN;EFFICIENCY: D;ENVIRONMENTAL EFFECTS: 01,D; EXHAUST GASES;FLOW RATE;GAS TURBINES: T1,D;GRAPHS: D;HEAT RECOVERY EQUIPMENT;ICES;NUMERICAL DATA: D;PERFORMANCE: 01,D; POWER PLANTS;REGENERATORS;TABLES: D;TEMPERATURE DISTRIBUTION; THERMODYNAMIC CYCLES

G-85

ACCESSION NO. — 79X0129869
TITLE(MONO) — HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM. PHASE II. TECHNOLOGY TEST AND SUPPORT STUDIES. TECHNICAL PROGRESS REPORT, APRIL 1-JUNE 30, 1976
CORPORATE AUTH — CURTISS-WRIGHT CORP., WOOD-RIDGE, NJ (USA)
SEC REPT NO — CW-WR--76-02032A
PAGE NO — 150
AVAILABILITY — DEP. NTIS, PC A07/MF A01.
CONTRACT NO — CONTRACT EX-76-C-01-2291
DATE — AUG 1976
CATEGORIES — EDB-200104
PRIMARY CAT — EDB-200104
REPORT NO — FE--2291-32A
ABSTRACT — WORK PERFORMED ON THE HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM, PHASE II - TECHNOLOGY TEST AND SUPPORT STUDIES DURING THE PERIOD FROM APRIL 1, 1976 THROUGH JUNE 30, 1976 IS SUMMARIZED. OBJECTIVES OF THE PROGRAM ELEMENTS AS WELL AS TECHNICAL PROGRESS AND PROBLEMS DURING THIS THIRD PHASE II REPORTING PERIOD ARE PRESENTED. PLANNED PROGRESS DURING THE NEXT REPORTING PERIOD IS ALSO DEFINED. PROGRESS ON PREPARATION OF TEST FACILITIES AND RIGS IS DESCRIBED. TESTING OF THE LP ENGINE COMBUSTOR SEGMENT WAS COMPLETED. SUPPORT ANALYSIS FOR THE TSTR COMBUSTOR DESIGN IS DETAILED. PREPARATION FOR MATERIALS TESTING ADVANCED, WITH SOME MESH SAMPLES BEING APPROVED FOR FINAL FABRICATION, PRIOR TO SETUP IN THE VARIOUS RIGS.
DESCRIPTORS — COAL;COMBINED-CYCLE POWER PLANTS;GAS TURBINES: T1;RESEARCH PROGRAMS: 01

G-86

ACCESSION NO. — 79J0129882
TITLE — ADVANCED POWER CYCLES AND THEIR POTENTIAL FOR ELECTRICAL ENERGY GENERATION
AUTHORS — FOX, G.R.
AUTHOR AFF — GENERAL ELECTRIC CO., SCHENECTADY, NY
PUB DESC — PROC. AM. POWER CONF., V. 40, PP. 464-476
SEC REPT NO — CONF-780440--
CONF TITLE — AMERICAN POWER CONFERENCE
CONF PLACE — CHICAGO, IL, USA
CONF DATE — APR 1978
DATE — 1978
CATEGORIES — EDB-200102;200104;300100
PRIMARY CAT — EDB-200102
ABSTRACT — A SUMMARY AND OVERVIEW ARE PRESENTED OF THE RESULTS OF STUDIES CONDUCTED BY GENERAL ELECTRIC TO EVALUATE THE PERFORMANCE AND ECONOMIC POTENTIAL OF A NUMBER OF ADVANCED ENERGY CONVERSION SYSTEMS EMPLOYING ADVANCED CYCLES USING COAL OR COAL-DERIVED FUELS. THESE ADVANCED ENERGY CONVERSION SYSTEMS, WHICH SHOULD MEET ENVIRONMENTAL STANDARDS AND HAVE IMPROVED EFFICIENCY, INCLUDE STEAM CYCLE WITH FLUIDIZED-BED COMBUSTOR, COMBINED-CYCLE GAS TURBINE, CLOSED-CYCLE HELIUM GAS TURBINE WITH ATMOSPHERIC FLUIDIZED BED, POTASSIUM TOPPING CYCLE WITH PRESSURIZED FLUIDIZED BED, AND OPEN-CYCLE MHD WITH STEAM BOTTOMING CYCLE. THE EFFICIENCY, POWER GENERATION COSTS, AND DEVELOPMENT TIME FORECASTS FOR THESE SYSTEMS ARE DISCUSSED AND COMPARED. (LCL)
DESCRIPTORS — AIR POLLUTION CONTROL;COAL;COMBINED-CYCLE POWER PLANTS: T2,D; COMMERCIALIZATION: 01,02,03,D;ECONOMICS: 01,02,D;EFFICIENCY: 03; FLUIDIZED-BED COMBUSTORS;FOSSIL-FUEL POWER PLANTS: T1,D;GAS TURBINES;GRAPHS: D;NUMERICAL DATA: D;OPEN-CYCLE MHD GENERATORS: T3,D;PERFORMANCE: 01,02;PLANTS;RELIABILITY;STEAM TURBINES; THERMODYNAMIC CYCLES: 01,02;TOPPING CYCLES

G-87

ACCESSION NO. 79C0129661
TITLE RELIABLE COMBUSTION TURBINES FOR ADVANCED POWER SYSTEMS
AUTHORS DUNCAN, R.L.; COOPER, V.R.
AUTHOR AFF ELECTRIC POWER RESEARCH INST., PALO ALTO, CA
PUB DESC PROC. AM. POWER CONF., V. 40, PP. 435-443
SEC REPT NO CONF-780440--
CONF TITLE AMERICAN POWER CONFERENCE
CONF PLACE CHICAGO, IL, USA
CONF DATE APR 1978
DATE 1978
CATEGORIES EDB-200102;200104
PRIMARY CAT EDB-200102
ABSTRACT THE NEED FOR RESEARCH ON GAS TURBINES FOR COMBINED-CYCLE POWER PLANTS, AND PARTICULARLY FOR RESEARCH EMPHASIZING RELIABILITY ASSURANCE, IS DISCUSSED, AND EPRI'S ACTIVITIES IN AND PLANS FOR SUCH RESEARCH ARE DESCRIBED. (LCL)
DESCRIPTORS COMBINED-CYCLE POWER PLANTS: T1;GAS TURBINES: T2,Q1; RELIABILITY: Q2;RESEARCH PROGRAMS: Q2;SPECIFICATIONS

G-88

ACCESSION NO. 79Y0123620
TITLE ADVANCES IN UTILIZING WOOD RESIDUE AND BARK AS FUEL FOR A GAS TURBINE
AUTHORS MOODY, D.R.
AUTHOR AFF COMBUSTION POWER CO., INC., MENLO PARK, CA
TITLE(MONO) TECHNOLOGY OF UTILIZING BARK AND RESIDUES AS AN ENERGY AND CHEMICAL RESOURCE
EDITOR OR COMP MATER, J.; MATER, M.H. (EDS.)
PAGE NO 47-72
PUBL LOC FOREST PRODUCTS RESEARCH SOCIETY, MADISON, WI
DATE 1976
CATEGORIES EDB-320301;090400;200103;140504
PRIMARY CAT EDB-320301
ABSTRACT GAS TURBINES EQUIPPED FOR DIRECT COMBUSTION OF WOOD RESIDUES, BARK, COAL, AND OTHER AVAILABLE FUELS CAN PROVIDE AN ENVIRONMENTALLY ACCEPTABLE, COST EFFECTIVE AND YET TECHNICALLY SIMPLE METHOD FOR MEETING THE FUTURE ELECTRICAL POWER NEEDS OF THE FOREST PRODUCTS INDUSTRY. THE ADVANCES THAT HAVE BEEN MADE IN THE DEVELOPMENT OF SUCH SYSTEMS ARE DESCRIBED. THE DISCUSSION INCLUDES COVERAGE OF THE REASON FOR THE INTEREST IN ALTERNATE FUELS, THE ADVANTAGES OF THE GAS TURBINE CYCLE, A DESCRIPTION OF THE PROBLEMS THAT ARE PRESENTLY BEING WORKED AND A REVIEW OF ASSOCIATED DEVELOPMENTS THAT ARE ALREADY BEING APPLIED IN THE FOREST PRODUCTS INDUSTRY.
DESCRIPTORS COMBUSTION: Q1;ENERGY CONSERVATION;FUELS: Q3;GAS TURBINES: T3; INDUSTRIAL PLANTS;POWER GENERATION: Q2;REVIEWS;WASTE MANAGEMENT; WOOD PRODUCTS INDUSTRY: T2;WOOD WASTES: T1

G-89

ACCESSION NO. 79J0122666
TITLE PRACTICAL EXPERIENCE WITH CRUDE AND HEAVY OIL IN STATIONARY GAS TURBINES
AUTHORS FELIX, P.C.
AUTHOR AFF BROWN, BOVERI AND CO. BADEN, SWITZ
PUB DESC BROWN BOVERI REV., V. 66, NO. 2, PP. 89-96
DATE FEB 1979
CATEGORIES EDB-200108
PRIMARY CAT EDB-200108
ABSTRACT THE PAPER CONSIDERS THE PROBLEMS WHICH ARISE WHEN A GAS TURBINE IS OPERATED WITH CRUDE OR HEAVY OIL. THE VARYING COMPOSITION OF THESE OILS CAN GREATLY INFLUENCE THE OPERATIONAL PERFORMANCE OF THE MACHINE, AFFECTING BOTH ITS AVAILABILITY AND ITS SERVICE LIFE.
DESCRIPTORS ALKALI METALS;ASHES;ECONOMICS;FOSSIL-FUEL POWER PLANTS;FUEL OILS: T2;FUEL SUBSTITUTION;GAS TURBINES: T1;MAINTENANCE; PETROLEUM;PHYSICAL PROPERTIES: Q1,Q2;RESIDUAL FUELS;SODIUM; VANADIUM

G-90

ACCESSION NO. 79J0122655
TITLE GAS TURBINE TYPE 13--RESULTS FROM A WIDE RANGE OF INDUSTRIAL APPLICATIONS
AUTHORS EIERMANN, A.
AUTHOR AFF BROWN, BOVERI AND CO. MANNHEIM, GER
PUB DESC BROWN BOVERI REV., V. 66, NO. 2, PP. 82-88
DATE FEB 1979
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT DESIGN FEATURES TECHNICAL DATA AND APPLICATIONS OF THE GAS TURBINE, TYPE 13, ARE GIVEN AS WELL AS OPERATIONAL EXPERIENCE GAINED WITH THE MOST IMPORTANT TURBINE COMPONENTS. WHEN USED AS A COMBINED PLANT, THE GAS TURBINE HAS DEMONSTRATED EXTREMELY LOW HEAT CONSUMPTION. A CAREFULLY PLANNED SERVICING AND MAINTENANCE PROGRAM ASSURES HIGH RELIABILITY AND AVAILABILITY.
DESCRIPTORS BOILERS;COMBINED-CYCLE POWER PLANTS;COMBUSTION CHAMBERS; COMPRESSORS;CORROSION;DESIGN: Q2;FOSSIL-FUEL POWER PLANTS: T1; GAS TURBINES: T2,Q1;HIGH TEMPERATURE;INSPECTION;MAINTENANCE; PERFORMANCE: Q2;RELIABILITY;WASTE HEAT UTILIZATION

G-91

ACCESSION NO. 79J0122640
TITLE SMALL GAS TURBINES FOR ELECTRIC POWER GENERATION
AUTHORS FRANCOIS, Y.F.
PUB DESC ANN. MINES, V. 185, NO. 4, PP. 77-84
DATE APR 1979
LANGUAGE IN FRENCH
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT THE SMALL GAS TURBINE PLAYS AN IMPORTANT ROLE IN THE DECENTRALIZED GENERATION OF BASE, SEMI-BASE, PEAK OR EMERGENCY ELECTRICITY. THE ARTICLE CITES THE CRITERIA FOR SELECTING GENERATING UNITS, BASED ON DIFFERENT TYPES OF APPLICATIONS, AND HIGHLIGHTS VARIOUS ADVANTAGES OF THE GAS TURBINE. THE CONCEPT OF ''TOTAL ENERGY'' FACILITIES IN EUROPE IS ALSO DISCUSSED.
DESCRIPTORS FRANCE;GAS TURBINES: T1;POWER GENERATION: Q1;REVIEWS: Q1; THERMAL POWER PLANTS;TOTAL ENERGY SYSTEMS

UNITS--ALTHOUGH ENERGY COSTS FOR SMALL COMMERCIAL WIND TURBINES CAN RUN TWO TO THREE TIMES THAT, DOE'S SHORT-RANGE GOAL FOR 200-KW-SIZE MACHINES IS 15-25 MILLS/KWH. BESIDES THE FICKLENESS OF LOCAL WIND CONDITIONS, TECHNICAL, ENVIRONMENTAL, AND SOCIAL PROBLEMS MUST BE ADDRESSED. WIND-TURBINE/GENERATORS ARE CATEGORIZED TODAY IN TERMS OF THE ORIENTATION OF THE AXIS OF ROTATION, RELATIVE TO THE WINDSTREAM. HORIZONTAL-AXIS, VERTICAL-AXIS, AND CROSS-WIND HORIZONTAL AXIS ROTORS ARE DESCRIBED. THE EXPERIENCE WITH SOME LARGE WECS IS RELATED. ALTHOUGH THE TECHNICAL FEASIBILITY OF WIND POWER HAS BEEN DEMONSTRATED MANY TIMES OVER, ITS FLUCTUATING NATURE AND THE HIGH COST OF EQUIPMENT STILL MAKE IT UNSUITABLE FOR MOST INDUSTRIAL AND UTILITY APPLICATIONS. IF OIL AND COAL PRICES CONTINUE TO ESCALATE, HOWEVER, WIND MIGHT SOON BECOME SUITABLE FOR ENERGY CONVERSION.

DESCRIPTORS	COST;TECHNOLOGY ASSESSMENT: Q1;US DOE;WIND POWER: T1;WIND TURBINES

G-92

ACCESSION NO.	79J0118712
TITLE	SPECIFIC EFFECTS OF SULFUR COMPOUNDS IN THE GASEOUS FLOW OF COMBUSTION PRODUCTS CONTAINING SEAWATER SALTS ON THERMAL FATIGUE FAILURE OF TURBINE ROTOR BLADES
AUTHORS	TRET'YACHENKO, G.N.; KOSYGIN, E.P.
AUTHOR AFF	ACAD OF SCI OF UKR SSR, INST OF PROBL OF STRENGTH OF MATER
PUB DESC	PROBL. PROCH., NO. 3, PP. 30-35
DATE	MAR 1979
LANGUAGE	IN RUSSIAN
CATEGORIES	EDB-360105
PRIMARY CAT	EDB-360105
ABSTRACT	RESULTS OF AN INVESTIGATION OF THE EFFECT OF AGGRESSIVE COMPONENTS OF THE GASEOUS FLOW OF COMBUSTION PRODUCTS OF FUELS, CHARACTERISTICS OF THE CONDITIONS OF OPERATION OF MARINE GAS TURBINE ENGINES, SULFUR COMPOUNDS, AND SEAWATER SALTS ON THERMAL CYCLE LIFE OF TURBINE ROTOR BLADES, THE KINETICS OF CRACK DEVELOPMENT, AND FAILURE OF THE MATERIAL ARE PRESENTED. IT IS SHOWN THAT UNDER A COMBINED EFFECT OF SEAWATER SALTS AND SULFUR A PARTICULARLY INTENSIVE DECLINE IN THE SERVICE LIFE IS OBSERVED.
DESCRIPTORS	COMBUSTION PRODUCTS: T3;CORROSION;CORROSIVE EFFECTS: Q3;CRACKS; DESIGN: Q2;GAS FLOW;GAS TURBINES: T1;SERVICE LIFE;SHIPS;SULFUR COMPOUNDS;THERMAL FATIGUE;TURBINE BLADES: T2,Q1

G-93 and G-94

ACCESSION NO.	79X0118369
TITLE(MONO)	BASELINE GAS TURBINE DEVELOPMENT PROGRAM. TWENTY-SECOND QUARTERLY PROGRESS REPORT
EDITOR OR COMP	PAMPREEN, R.C.; WAGNER, C.E.
ED AFF	COMPS. AND EDS.
CORPORATE AUTH	CHRYSLER CORP., DETROIT, MI (USA)
PAGE NO	80
AVAILABILITY	DEP. NTIS, PC A05/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2749
DATE	30 APR 1976
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	COO--2749-31
ABSTRACT	PROGRESS IS REPORTED FOR A PROGRAM WHOSE GOALS ARE TO DEMONSTRATE AN EXPERIMENTAL UPGRADED GAS TURBINE-POWERED AUTOMOBILE WHICH MEETS THE 1978 FEDERAL EMISSIONS STANDARDS, HAS SIGNIFICANTLY IMPROVED FUEL ECONOMY, AND IS COMPETITIVE IN PERFORMANCE, RELIABILITY, AND POTENTIAL MANUFACTURING COST WITH THE CONVENTIONAL PISTON ENGINE-POWERED, COMPACT-SIZE AMERICAN AUTOMOBILE. ACTIVITY DURING THIS TWENTY-SECOND PROGRAM QUARTER HAS CONTINUED TO EMPHASIZE DEVELOPMENT TOWARDS CORRECTING A POWER DEFICIENCY IN THE UPGRADED ENGINE. EFFORTS ARE ALSO BEING DIRECTED TOWARDS REDUCING FUEL USAGE THROUGH IMPROVED HEAT RECOVERY AND TOWARDS IMPROVING THE MECHANICAL RELIABILITY AND CONTROL OF THE ENGINE.
DESCRIPTORS	AUTOMOBILES: T1;DESIGN;GAS TURBINES: T2,Q1;RESEARCH PROGRAMS: Q2

G-95

ACCESSION NO.	79C0118191
TITLE	OPTIMAL SYSTEM CONFIGURATION TOTAL ENERGY ANALYSIS FOR A LARGE MILITARY INSTALLATION
AUTHORS	BEST, F.R.; GOLDMAN, S.B.; GOLAY, M.W.
AUTHOR AFF	MASSACHUSETTS INST. OF TECH., CAMBRIDGE
TITLE(MONO)	HEAT TRANSFER IN ENERGY CONSERVATION
EDITOR OR COMP	GOLDSTEIN, R.J.; DIDION, D.; GOPAL, R.; KREIDER, K.; SCHOENHALS, R. (EDS.)
SEC REPT NO	CONF-771120--P6
PAGE NO	113-119
CONF TITLE	WINTER ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
CONF PLACE	ATLANTA, GA, USA
CONF DATE	27 NOV 1977
PUBL LOC	AMERICAN SOCIETY OF MECHANICAL ENGINEERS, NEW YORK, NY
DATE	1977
CATEGORIES	EDB-320103;290600
PRIMARY CAT	EDB-320103
ABSTRACT	A TOTAL ENERGY SYSTEM (TES) IS DESIGNED TO SUPPLY THE THERMAL AND ELECTRICAL ENERGY REQUIREMENTS OF FORT KNOX, KENTUCKY FOR A PERIOD OF 30 YEARS, WITH STARTUP SCHEDULED FOR EARLY 1985. CONSIDERED FOR USE AS THE CENTRAL STATION POWER PLANT FOR THIS SYSTEM ARE A COMBINED COAL GASIFICATION, FOSSIL-FIRED GAS TURBINE (CGGT) POWER PLANT AND A DIRECT BRAYTON CYCLE HIGH-TEMPERATURE GAS-COOLED REACTOR, HELIUM GAS TURBINE (HTGR/GT) POWER PLANT. SEVERAL UTILITY SYSTEM CONFIGURATIONS AFFORDING DIFFERENT THERMAL/ELECTRICAL ENERGY DEMAND RATIOS ARE STUDIED FOR EACH SUPPLY OPTION, WITH THE PRIMARY SYSTEM OPTIMIZATION CRITERION BEING THE CHOICE OF THE TES PROVIDING A MINIMUM OF TOTAL ENERGY COSTS OVER THE SYSTEM LIFETIME. IT IS FOUND THAT THE OPTIMAL THERMAL/ELECTRICAL LOAD SPLIT FOR EACH SUPPLY OPTION OCCURS AT APPROXIMATELY 80% OF THE BASE'S TOTAL ENERGY DEMANDS SUPPLIED THERMALLY. WITHIN THE LIMITS OF THE UNIT-COST ASSUMPTIONS MADE AND FOR THE RANGE OF CASES STUDIED, IT IS FOUND THAT THE PRESENT-WORTH TOTAL COST OF THE OPTIMIZED

G-96

ACCESSION NO.	79X0116614
TITLE(MONO)	PFB COAL FIRED COMBINED CYCLE DEVELOPMENT PROGRAM: MANAGEMENT PLAN UPDATE
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). ENERGY SYSTEMS PROGRAMS DEPT.
PAGE NO	33
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-2357
DATE	ND*
CATEGORIES	EDB-200104;421000;014000
PRIMARY CAT	EDB-200104
REPORT NO	FE--2357-43
ABSTRACT	THE FOLLOW-ON PROGRAM CONCENTRATES CONTINUING ACTIVITY IN TWO MAJOR TECHNOLOGY TASKS OF THE CURRENT CFCC PROGRAM, HOT GAS CLEANUP AND GAS TURBINE LIFE, WITH SUPPORTING EFFORT IN SEVERAL OTHER AREAS. THE PRIME THRUST OF THE FOLLOW-ON PROGRAM IS IN GAS TURBINE TECHNOLOGY AND HOT GAS CLEANUP. WORK TO DATE HAS IDENTIFIED THE NEEDS TO PROTECT THE GAS TURBINE FROM CORROSION CAUSED BY SUBSTANTIAL AMOUNTS OF ALKALI IN THE SUBMICRON AEROSOL AND VAPOR PHASE AND TO PROTECT THE TURBINE FROM EROSION CAUSED BY MULTIMICRON-SIZED PARTICULATES. WE BELIEVE THAT A SOLUTION TO THE CORROSION PROTECTION CHALLENGE CAN MORE CONFIDENTLY AND QUICKLY BE FOUND BY EXTENDING TURBINE MATERIALS WORK IN DIRTY LIQUID FUELS TO THE PFB ENVIRONMENTAL LEVELS. PARTICULATE REMOVAL FOR EROSION PROTECTION HAS AS ITS OBJECTIVE A BETTER QUANTIFICATION OF THE EROSION TOLERANCE LEVEL COUPLED WITH WORK TO IMPROVE THE PERFORMANCE OF INERTIAL SEPARATORS, INCLUDING ELECTROSTATIC AUGMENTATION, IN THE LESS-THAN-15 $MUSM-PARTICLE-SIZE REGION. INTERACTION BETWEEN THE ONGOING TECHNOLOGY AND TEST PROGRAMS AT THE COAL UTILIZATION RESEARCH LABORATORY WILL BE BY THE DESCRIBED TESTS TO BE PERFORMED. ADDITIONALLY, USE WILL BE MADE OF THE RESULTS OF THE FIRESIDE II CORROSION PROGRAM RESULTS FROM THE PLANNED 1000-HOUR TEST AT THE EXXON MINI-PLANT PFB. THE FOLLOW-ON EFFORT, THEN, IS KEYED TO THE RESULTS OF THESE PFB TESTS AND CONCLUSIONS REACHED FROM IN-DEPTH PARALLEL LABORATORY INVESTIGATIONS AND ANALYSIS.
DESCRIPTORS	ALKALI METAL COMPOUNDS: T3;COMBINED-CYCLE POWER PLANTS: T1; CORROSION;CORROSION PROTECTION: Q2;CORROSIVE EFFECTS: Q3; DESIGN: Q1;EROSION;FLUIDIZED-BED COMBUSTORS;GAS TURBINES: T2; HOT GAS CLEANUP;MANAGEMENT;PARTICLES;PLANNING;REMOVAL

G-97

ACCESSION NO.	79X0116778
TITLE(MONO)	CFCC DEVELOPMENT PROGRAM. ANNUAL PROGRESS REPORT, JULY 1976--JUNE 1977
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). ENERGY SYSTEMS PROGRAMS DEPT.
PAGE NO	225
AVAILABILITY	DEP. NTIS, PC A10/MF A01.
CONTRACT NO	CONTRACT EX-76-C-01-2357
DATE	SEP 1978
CATEGORIES	EDB-200104;421000;010402
PRIMARY CAT	EDB-200104
REPORT NO	FE--2357-24
ABSTRACT	DURING THE FIRST YEAR OF THE CFCC DEVELOPMENT PROGRAM SUBSTANTIAL PROGRESS WAS MADE IN ESTABLISHING A COMMERCIAL PLANT CONCEPT. THE OVERALL APPROACH TO THE COMMERCIAL PLANT DESIGN EVALUATION WITH SUPPORTING TECHNOLOGY TASKS HAS BEEN DEFINED. RELIABILITY STUDIES AND EVALUATION OF ALTERNATE PLANT DESIGNS WERE CONDUCTED IN PARALLEL WITH THE DESIGN ACTIVITY. AN ENVIRONMENTAL ASSESSMENT WAS ALSO CONDUCTED IN PARALLEL WITH THE DESIGN ACTIVITY. THE TEST RESULTS HAVE CONFIRMED THE BASIC ASSUMPTIONS ON HEAT TRANSFER AND SEVERAL CONFIGURATIONS USING THE SAME BASIC TUBE BUNDLE THAT HAVE BEEN EVALUATED. THE HOT GASES GENERATED IN THE COMBUSTOR STEAM GENERATOR MUST BE SUBSEQUENTLY CLEANED UP, I.E., A HIGH PERCENTAGE OF PARTICULATE MATTER REMOVED IN THE HOT GAS CLEAN-UP SYSTEM, BEFORE THEY ARE EXPANDED IN THE GAS TURBINE. THE INITIAL EMPHASIS IN THE HOT GAS CLEAN-UP EFFORT WAS TO COMPILE EXISTING EFFLUX DATA AND ANALYZE IT TO DEVELOP AN EFFLUX CHARACTERIZATION. A SECOND STEP IS THEN TO DETERMINE THE PARTICULATE REMOVAL CAPABILITIES OF EXISTING CLEAN-UP DEVICES AS A FUNCTION OF PARTICLE SIZE DISTRIBUTION. THE BASIC CORROSION PROBLEM IN THE GAS TURBINE AND IN THE COMBUSTOR STEAM GENERATOR ARISES FROM THE CHEMICAL SPECIES IN THE GAS STREAM FROM A FLUID BED COMBUSTOR. AN ANALYTICAL EFFORT IS IN PROGRESS TO BETTER DEFINE THESE VARIOUS SPECIES, THE PARAMETERS WHICH EFFECT THEIR GENERATION AND DEPOSITION, AND AN ASSESSMENT OF THEIR QUANTITIES AND STATES AT THE TIME THAT THEY REACH THE FIRST STAGE OF THE GAS TURBINE.
DESCRIPTORS	COMBINED-CYCLE POWER PLANTS: T1;CORROSION;CYCLONE SEPARATORS; DESIGN: Q1;ENVIRONMENTAL EFFECTS;EROSION;FILTERS;FLUIDIZED-BED COMBUSTORS;GAS TURBINES: T2;GRANULAR BED FILTERS;HOT GAS CLEANUP;MATERIALS: Q2;PARTICLES;REMOVAL;STEAM TURBINES

G-99

ACCESSION NO.	79R0116769
TITLE(MONO)	ADVANCED COAL FUELED COMBUSTOR/HEAT EXCHANGER TECHNOLOGY STUDY. QUARTERLY TECHNICAL PROGRESS REPORT NO. 5, OCTOBER-DECEMBER 1978
EDITOR OR COMP	CAMPBELL, J. JR.
CORPORATE AUTH	ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA (USA). ROCKETDYNE DIV.
PAGE NO	79
AVAILABILITY	DEP. NTIS, PC A05/MF A01.
CONTRACT NO	CONTRACT EF-77-C-01-2612
DATE	1978
CATEGORIES	EDB-200102;290800
PRIMARY CAT	EDB-200102
REPORT NO	FE--2612-25
ABSTRACT	THIS EFFORT CONSTITUTES THE FIRST PHASE OF WHAT IS EXPECTED TO BE A THREE-PHASE PROGRAM TO ADVANCE COAL FUELED COMBUSTOR/HEAT EXCHANGER TECHNOLOGY. THE TECHNOLOGY WOULD BE UTILIZED IN CONJUNCTION WITH HIGH TEMPERATURE CLOSED CYCLE GAS TURBINE, (CCGT), POWER CONVERSION SYSTEMS. THE PRESENT EFFORT CONSISTS ENTIRELY OF STUDIES, ANALYSIS, DESIGN, AND REPORTING. NO FABRICATION OR TEST EFFORT IS INVOLVED. THIS 1977--1978 EFFORT WAS CONCERNED WITH CCGT CYCLES AND HEAT EXCHANGERS APPROPRIATE FOR A 350 MWE UNIT SIZE CENTRAL STATION APPLICATION. A CONTRACT EXTENSION WAS GRANTED TO ROCKWELL INTERNATIONAL TO PROVIDE ADDITIONAL EFFORT TO ESTABLISH RELEVANT CCGT SYSTEM DESIGNS, PARTICULARLY PRIMARY HEATER DESIGNS, SUITABLE FOR SMALLER GENERATING SYSTEMS PROVIDING BOTH ELECTRIC POWER IN THE 25 TO 50 MWE RANGE AND USEFUL PROCESS HEAT. SUCH SYSTEMS WOULD BE EXPECTED TO FIND APPLICATION IN COGENERATION SERVICE IN LARGE INDUSTRIAL PLANTS, OR IN DISTRICT HEATING APPLICATIONS, ETC., WHERE THE SIMULTANEOUS DEMAND FOR BOTH PROCESS HEAT AND ELECTRICAL POWER PERMITS ADDED ECONOMIES IN FUEL UTILIZATION.
DESCRIPTORS	BOTTOMING CYCLES;CLOSED-CYCLE SYSTEMS;CO-GENERATION: T2;COMBUSTORS;COMPARATIVE EVALUATIONS;DESIGN;DISTRICT HEATING;EXPERIMENTAL DATA: D;FEASIBILITY STUDIES: U1,U2,D;GAS TURBINE POWER PLANTS: T1,D;GAS TURBINES;GRAPHS: D;HEAT EXCHANGERS;PROCESS HEAT;RESEARCH PROGRAMS;STEAM;STEAM TURBINES;TABLES: D;THERMAL EFFICIENCY: U1,D;THERMODYNAMIC CYCLES;WATER

G-100

ACCESSION NO.	79J0112688
TITLE	INFLUENCE OF FUEL COMPOSITION ON SMOKE EMISSION FROM GAS-TURBINE-TYPE COMBUSTORS: EFFECT OF COMBUSTOR DESIGN AND OPERATING CONDITIONS
AUTHORS	FRISWELL, N.J.
AUTHOR AFF	SHELL RES LTD, CHESTER, ENGL
PUB DESC	COMBUST. SCI. TECHNOL., V. 19, NO. 3-4, PP. 119-127
DATE	1979
CATEGORIES	EDB-421000
PRIMARY CAT	EDB-421000
ABSTRACT	THE INFLUENCE OF FUEL COMPOSITION ON SMOKE EMISSION/COMBUSTOR WALL TEMPERATURES WAS STUDIED IN A LABORATORY-SCALE GAS-TURBINE-TYPE COMBUSTOR OVER THE RANGE OF OPERATING CONDITIONS OF MODERN TURBINE COMBUSTORS AND AS A FUNCTION OF COMBUSTOR DESIGN. FUEL HYDROGEN CONTENT IS SHOWN TO GIVE THE BEST PREDICTION OF SMOKE EMISSION AND OF VARIATIONS IN FLAME TUBE WALL TEMPERATURE CAUSED BY CHANGES IN FLAME RADIATION. THE MAJOR FINDING IS THAT THE INFLUENCE OF FUEL COMPOSITION ON SMOKE EMISSION/FLAME RADIATION FALLS VIRTUALLY TO ZERO AT COMBUSTOR PRESSURES ABOVE ABOUT 10 BAR. 9 REFS.
DESCRIPTORS	CHEMICAL COMPOSITION;COMBUSTORS: T1;DESIGN;EMISSION;EXHAUST GASES: U1,U2;FUELS;GAS TURBINES: T2;HYDROGEN;OPERATION;SMOKES;TRANSMISSION ELECTRON MICROSCOPY

G-101

ACCESSION NO.	79R0106370
TITLE(MONO)	ASSESSMENT OF THE STATE OF THE ART OF PRESSURIZED FLUIDIZED BED COMBUSTION SYSTEMS
EDITOR OR COMP	FRAAS, A.P.; GRAVES, R.L.; LACKEY, M.E.
CORPORATE AUTH	OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO	56
AVAILABILITY	P 04/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-26
DATE	16 MAY 1979
CATEGORIES	EDB-421000;014000
PRIMARY CAT	EDB-421000
REPORT NO	ORNL/TM--6633
ABSTRACT	THIS REPORT WAS PREPARED AT THE REQUEST OF THE TENNESSEE VALLEY AUTHORITY (TVA) TO CLARIFY THE DEVELOPMENT STATUS OF THE PRESSURIZED FLUIDIZED BED COMBUSTION (PFBC) AND TO PLACE IN PERSPECTIVE THE PROBLEMS WHICH ARE YET TO BE SOLVED BEFORE COMMERCIALIZATION OF THE CONCEPT IS PRACTICAL. THE REPORT IS VIEWED AS PRELIMINARY TO A MORE COMPLETE AND COMPREHENSIVE WORK TO BE CARRIED OUT DURING FY 1979. AN EVALUATION OF THE PFBC CONCEPT CITES POTENTIAL ADVANTAGES OVER ATMOSPHERIC PRESSURE FLUIDIZED BED COMBUSTORS (AFBC) IN THE AREAS OF COMBUSTION EFFICIENCY, SULFUR RETENTION, FURNACE DESIGN, POWER PLANT EFFICIENCY, AND OTHERS. THE KEY DISADVANTAGE OF UNPROVEN HOT GAS CLEANUP AND ASSOCIATED GAS TURBINE TECHNOLOGY IS DISCUSSED IN CONSIDERABLE DETAIL. A SURVEY OF EXISTING AND DEVELOPING PFBC EXPERIMENTAL FACILITIES IS PRESENTED PLUS SOME RESULTS FROM THE EXPERIMENTAL PROGRAMS. RECENT DESIGN STUDIES FOR FULL-SIZED PFBC POWER PLANTS ARE REVIEWED WITH EMPHASIS ON KEY DESIGN PARAMETERS. RESULTS FOR SIMILAR AFBC DESIGN STUDIES ARE PRESENTED IN CONTRAST. THE GENERAL CONCLUSION DRAWN FROM THIS PRELIMINARY SURVEY IS THAT THE POTENTIAL ADVANTAGES OF THE PRBC USED IN CONJUNCTION WITH A HIGH-TEMPERATURE 850$SUP 0$C (1560$SUP 0$F)* GAS TURBINE WILL BE DIFFICULT TO REALIZE DUE

PRIMARILY TO THE FORMIDABLE TASK OF DEVELOPING ADEQUATE HOT GAS CLEANUP AND TURBINE SYSTEMS, AND DUE TO THE ANTICIPATED HIGH COST OF THESE SYSTEMS.

DESCRIPTORS	COAL;COMBUSTION;COMPARATIVE EVALUATIONS: Q1;COST;CYCLONE SEPARATORS;DEPOSITS;DESIGN: Q1;EFFICIENCY: Q2;EROSION; FLUIDIZED-BED COMBUSTION: T2;FLUIDIZED-BED COMBUSTORS: T1;FUEL FEEDING SYSTEMS: Q1;GAS TURBINES: T;HOT GAS CLEANUP: T;MEDIUM PRESSURE;PARTICLES;REVIEWS: Q1;TEMPERATURE DEPENDENCE

G-102

ACCESSION NO.	79X0105535
TITLE(MONO)	BASELINE GAS TURBINE DEVELOPMENT PROGRAM. TWENTY-THIRD COMBINED QUARTERLY PROGRESS REPORT, MAY 1, 1976--JANUARY 31, 1979
EDITOR OR COMP	PAMPREEN, R.C.; WAGNER, C.E.
ED AFF	COMPS.
CORPORATE AUTH	CHRYSLER CORP., DETROIT, MI (USA)
PAGE NO	62
AVAILABILITY	P 04/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2749
DATE	31 DEC 1978
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	COO--2749-39
ABSTRACT	PROGRESS IS REPORTED FOR A PROGRAM WHOSE GOALS ARE TO DEMONSTRATE AN EXPERIMENTAL UPGRADED GAS TURBINE-POWERED AUTOMOBILE WHICH MEETS THE 1978 FEDERAL EMISSIONS STANDARDS, HAS SIGNIFICANTLY IMPROVED FUEL ECONOMY, AND IS COMPETITIVE IN PERFORMANCE, RELIABILITY, AND POTENTIAL MANUFACTURING COST WITH THE CONVENTIONAL PISTON ENGINE-POWERED, COMPACT-SIZE AMERICAN AUTOMOBILE. THIS IS THE CONCLUDING PROGRESS REPORT FOR THIS PROGRAM; IT COVERS THE PERIOD FROM MAY 1, 1976 TO JANUARY 31, 1979. THE NEXT FORMAL REPORT WILL BE THE FINAL REPORT, WHICH IS CURRENTLY IN PROCESS. ACTIVITY DURING THIS REPORTING PERIOD HAS CONTINUED TO EMPHASIZE DEVELOPMENT TOWARDS CORRECTING A POWER DEFICIENCY IN THE UPGRADED ENGINE. EFFORTS ARE ALSO BEING DIRECTED TOWARDS REDUCING FUEL USAGE THROUGH IMPROVED HEAT RECOVERY AND TOWARDS IMPROVING THE MECHANICAL RELIABILITY AND CONTROL OF THE ENGINE.
DESCRIPTORS	AUTOMOBILES: T1;DESIGN;GAS TURBINES: T2,Q1;RESEARCH PROGRAMS: Q2

G-103

ACCESSION NO.	79C0104214
TITLE	ELECTRIC UTILITY FOSSIL FUELS BEYOND 1985
AUTHORS	WOLK, R.H.; VEJTASA, S.A.
AUTHOR AFF	ELECTRIC POWER RESEARCH INST., PALO ALTO, CA
PUB DESC	PREPR., DIV. PET. CHEM., AM. CHEM. SOC., V. 23, NO. 4, PP. 1350-1359
SEC REPT NO	CONF-780902--P4
CONF TITLE	AMERICAN CHEMICAL SOCIETY MEETING
CONF PLACE	MIAMI, FL, USA
CONF DATE	10 SEP 1978
DATE	SEP 1978
CATEGORIES	EDB-200108;015000;296001
PRIMARY CAT	EDB-200108
ABSTRACT	THE UTILITY INDUSTRY MUST ANTICIPATE THE DAY WHEN THEY WILL HAVE EXTREMELY LIMITED ACCESS TO NATURAL GAS AND PETROLEUM FOR POWER GENERATING PURPOSES. THEY ARE SPONSORING RESEARCH AND DEVELOPMENT ON A WIDE VARIETY OF PROCESSES THAT WILL PROVIDE ENVIRONMENTALLY ACCEPTABLE COAL-DERIVED FUELS. POTENTIAL MARKETS HAVE BEEN IDENTIFIED FOR LIQUID BOILER, TURBINE, AND COMBINED CYCLE FUELS, SOLID FUEL (SRC), METHANOL, AND INTERMEDIATE BTU GAS. THE PENETRATION OF THESE FUELS INTO THE MARKET WILL DEPEND STRONGLY ON THEIR RELATIVE PRICE AND THE ENVIRONMENTAL CONSTRAINTS THAT A GIVEN UTILITY MUST DEAL WITH.
DESCRIPTORS	BOILER FUEL: Q1;COAL;COAL LIQUIDS: T3;COMBINED-CYCLE POWER PLANTS: T2;COMPARATIVE EVALUATIONS;COST: Q4;FOSSIL-FUEL POWER PLANTS: T1;FUEL SUBSTITUTION: Q1,Q2;FUELS: Q2;GAS TURBINES; INTERMEDIATE BTU GAS;LIQUID FUELS: T4;LOW BTU GAS;METHANOL; PYROLYSIS;REFINING: Q3;SOLVENT-REFINED COAL

G-104

ACCESSION NO.	79J0104209
TITLE	PRELIMINARY DESIGN ANALYSIS OF A CATALYTIC CERAMIC STRUCTURE IN A TURBINE COMBUSTOR
AUTHORS	HUNG, W.S.Y.; DICKSON, W.H.; DECORSO, S.M.
AUTHOR AFF	WESTINGHOUSE ELECTR CORP, PHILADELPHIA, PA
PUB DESC	AM. SOC. MECH. ENG., _PAP.*, NO. 76-WA/GT-1, PP. 1-9
DATE	DEC 1976
CATEGORIES	EDB-200104;360200;424000
PRIMARY CAT	EDB-200104
ABSTRACT	ANALYSIS AND DESIGN OF A CATALYTIC CERAMIC ELEMENT AND ITS SUPPORT STRUCTURE IN A TURBINE COMBUSTOR FOR LOW EMISSION APPLICATION HAVE BEEN PERFORMED. PRELIMINARY ANALYSIS INCLUDING A SURVEY OF LITERATURE HAS HELPED IDENTIFY CERTAIN DESIGN CONSIDERATIONS AND CONCEPTUAL DESIGNS OF THE CATALYTIC CERAMIC ELEMENT. A THERMO-MECHANICAL ANALYSIS OF THE MAJOR COMPONENTS IN THESE CONCEPTUAL DESIGNS HAS BEEN PERFORMED FOR BOTH STEADY-STATE AND TRANSIENT (SHUT-DOWN) SITUATIONS. CONSEQUENTLY, AN ARRANGEMENT TO BUILD A VIABLE CATALYTIC CERAMIC COMBUSTOR ELEMENT HAS BEEN IDENTIFIED WHICH IS EXPECTED TO PERFORM ITS MECHANICAL FUNCTIONS. 24 REFS.
DESCRIPTORS	CATALYTIC COMBUSTORS: Q1,T2;CERAMICS: T3;DESIGN: Q2;GAS TURBINES: T1;MATERIALS;POLLUTION CONTROL;USES: Q3

G-105

ACCESSION NO.	79J0099139
TITLE	EXTERNALLY-FIRED GAS TURBINE
AUTHORS	FACEY, J.
AUTHOR AFF	DEPT. OF ENERGY, WASHINGTON, DC
PUB DESC	PUBLIC POWER, V. 36, NO. 2, P. 54
DATE	MAR 1978
CATEGORIES	EDB-200104;425001
PRIMARY CAT	EDB-200104
ABSTRACT	DEVELOPMENT AND DEMONSTRATION OF THE TECHNOLOGY FOR EXTERNALLY-FIRED GAS TURBINES OPERATING EITHER AS INDIRECTLY-FIRED OPEN OR CLOSED CYCLES ARE THE OBJECTIVES OF A PROJECT OF THE DEPARTMENT OF ENERGY'S DIVISION OF POWER SYSTEMS. MAJOR EMPHASIS IS ON STATIONARY PRIME MOVERS OF UP TO 20 MW IN SIZES FOR DISPERSED POWER GENERATION APPLICATIONS. A MAJOR GOAL OF THE EXTERNALLY FIRED BRAYTON PROJECT IS TO DEVELOP A RELIABLE GAS TURBINE THAT CAN BE USED WITH A VARIETY OF HEAT SOURCES OTHER THAN HIGH GRADE PETROLEUM OR NATURAL GAS FUELS.
DESCRIPTORS	BRAYTON CYCLE;CO-GENERATION;FOSSIL-FUEL POWER PLANTS: T1;GAS TURBINES: T2,Q1;RESEARCH PROGRAMS;THERMAL EFFICIENCY;US DOE: USES: G2

G-106

ACCESSION NO.	79J0099126
TITLE	POSSIBILITIES FOR THE REPAIR OF HOT SECTION PARTS OF STATIONARY GAS TURBINES
PUB DESC	TURBOMACH. INT., V. 20, NO. 1, PP. 13-17
DATE	JAN-FEB 1979
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
ABSTRACT	A GAS TURBINE WITH A CAPACITY OF 30 MW COSTS ABOUT $3 MILLION. ANNUAL EXPENDITURES ON SPARE PARTS FOR MAINTENANCE AND REPAIR CAN AMOUNT TO $300,000, AND ABOUT $150,000 IS REQUIRED FOR DISMANTLING AND RE-ASSEMBLY OF THE TURBINE FOR ROUTINE MAINTENANCE. THIS ARTICLE IS DIRECTED TOWARDS THE USER OF TURBOMACHINERY IN HELPING TO UNDERSTAND THE VARIOUS PROBLEMS, TECHNIQUES AND SOLUTIONS ASSOCIATED WITH MAINTENANCE AND REPAIR OF BUCKETS, VANES AND COMBUSTION PARTS FOR GAS TURBINES. THIS PARTICULAR FEATURE FOCUSES ON ONE ASPECT IN THE REPAIR OF DAMAGED GAS TURBINE PARTS AND THE COMPLEXITIES REPAIR SHOPS ARE INVOLVED IN.
DESCRIPTORS	CORROSION;GAS TURBINES: T1;MAINTENANCE;REPAIR: Q1;ROTORS; TURBINE BLADES

G-107

ACCESSION NO.	79X0098381
TITLE(MONO)	INVESTIGATION OF THE VIABILITY AND COST EFFECTIVENESS OF SOLID FUEL GASIFIERS CLOSE COUPLED TO INTERNAL COMBUSTION ENGINES FOR 200 KWE POWER GENERATION. TECHNICAL PROGRESS REPORT NO. 9
EDITOR OR COMP	MINGLE, J.G.; JUNGE, D.C.
CORPORATE AUTH	OREGON STATE UNIV., CORVALLIS (USA)
SEC REPT NO	RLO--2227-T22-13
PAGE NO	53
AVAILABILITY	P 04/MF A01.
CONTRACT NO	CONTRACT EY-76-S-06-2227-022
DATE	JAN 1979
CATEGORIES	EDB-010404;090122
PRIMARY CAT	EDB-010404
REPORT NO	DOE/RL/90476--13
ABSTRACT	THE VIABILITY AND COST EFFECTIVENESS OF A 200 KWE ENGINE GENERATOR UNIT FUELED BY A DIRECT COUPLED, SOLID FUEL GASIFIER WERE STUDIED. RECENT LITERATURE DESCRIBING GASIFIER TECHNOLOGY WAS OBTAINED AND PERSONAL VISITS WERE MADE TO TEST FACILITY SITES AND ENGINE MANUFACTURING PLANTS TO DISCUSS THE SUBJECT WITH RESEARCHERS AND ENGINEERS. TWO PROTOTYPE UNITS WERE INSPECTED, ONE OF WHICH WAS IN PARTIAL OPERATION. THIS REPORT PRESENTS A BRIEF DISCUSSION OF FUEL AND GASIFIER TECHNOLOGY, GAS TREATMENT (CLEAN UP) FOR ENGINE USE, ENGINE USE TECHNOLOGY, OTHER USES FOR GASIFIERS, THE VIABILITY OF CLOSE COUPLED UNITS, AND AN ESTIMATE OF COST EFFECTIVENESS. PRESENT SMALL EXPERIMENTAL GASIFIER SYSTEMS PERFORM AS EXPECTED AND HAVE SERVED TO DEMONSTRATE THE TECHNOLOGY. TYPICALLY THEY OPERATE WITH FUEL SPECIES WHICH ARE PRESENT AND COLLECTED ON THE SITE OF A PROCESSING PLANT. CERTAIN NEEDED DEVELOPMENT EFFORTS ARE DISCUSSED. ALSO, FUEL MUST BE AVAILABLE AT LOW COST AND EVEN THEN ELECTRIC POWER PRODUCED IN THIS WAY IS UNLIKELY TO BE COMPETITIVE ECONOMICALLY WHERE UTILITY POLES ARE AVAILABLE. (LTN)
DESCRIPTORS	AGRICULTURAL WASTES: T3;BIOMASS: T2;CARBONACEOUS MATERIALS: T1; CHEMICAL COMPOSITION: Q7;COAL GASIFICATION;COAL TAR;COMBUSTION: Q7;COMPARATIVE EVALUATIONS: Q5,Q6;CONTROL SYSTEMS;COOLING: Q7; COST;DIESEL ENGINES;ECONOMIC ANALYSIS;ELECTRIC POWER;FUEL FEEDING SYSTEMS: Q8;FUEL GAS: T7;FUEL SUBSTITUTION;FUEL-AIR RATIO: Q6;GAS TURBINES;GASIFICATION: T5,Q1,Q2,Q3,Q4;LOW BTU GAS; PARTICLES;PURIFICATION;PYROLYSIS: T6;REMOVAL;SPARK IGNITION ENGINES: T8;VEHICLES;WASTE HEAT UTILIZATION;WATER;WOOD WASTES: T4

G-108

ACCESSION NO.	79R0093221
TITLE(MONO)	ERICSSON CYCLE GAS TURBINE POWERPLANTS
EDITOR OR COMP	KRASE, W.H.
CORPORATE AUTH	RAND CORP., SANTA MONICA, CA (USA)

PAGE NO 45
AVAILABILITY DEP. NTIS. PC A03/MF A01.
CONTRACT NO CONTRACT EX-76-C-01-2337
DATE MAR 1979
CATEGORIES EDB-200100
PRIMARY CAT EDB-200100
REPORT NO RAND/R--2327-DOE
ABSTRACT A PRELIMINARY EXPLORATION IS MADE OF A POTENTIALLY LOW-COST GAS TURBINE THERMODYNAMIC CYCLE THAT APPEARS CAPABLE OF UNPRECEDENTED EFFICIENCY. THE CYCLE IS AN APPROXIMATION TO AN ERICSSON CYCLE AND USES STEPWISE EXPANSIONS IN TURBINES WITH INTERVENING REHEAT AND STEPWISE COMPRESSION WITH INTERVENING INTERCOOLING. THE CYCLE ALSO USES A HIGH-EFFECTIVENESS RECUPERATOR. AT A PEAK CYCLE TEMPERATURE OF 1500$SUP 0$F. AND USING FIVE STAGES OF COMPRESSION AND EXPANSION, A 50% THERMAL EFFICIENCY IS ATTAINABLE WITH COMPONENT PERFORMANCE THAT HAS ALREADY BEEN DEMONSTRATED. (PRESENT UTILITY PLANTS HAVE A THERMAL EFFICIENCY IN THE RANGE OF 35 TO 40%). AT 1600$SUP 0$F. THE THERMAL EFFICIENCY REACHES 56%. THIS PERFORMANCE IS ACHIEVABLE WITHOUT GOING TO EXTREMES OF TEMPERATURE OR PRESSURE. WITHOUT INTRODUCING NEW MATERIALS. AND WITHOUT INTRODUCING FUNDAMENTALLY NEW TECHNIQUES.
DESCRIPTORS FEASIBILITY STUDIES: Q1;GAS TURBINES;THERMAL EFFICIENCY;THERMAL POWER PLANTS: T1

G-109

ACCESSION NO. 79C0068407
REPORT NO.PAGE CONF-7605102--(SUMM PP. 461-463
TITLE GREYHOUND/DOE TURBINE-POWERED INTERCITY BUS DEMONSTRATION PROGRAM
AUTHORS BADE, N.E.
TITLE(MONO) HIGHWAY VEHICLE SYSTEMS: CONTRACTORS COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO 461-463
CONF TITLE HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE TROY, MI, USA
CONF DATE 9 MAY 1976
DATE SEP 1976
CATEGORIES EDB-330103
PRIMARY CAT EDB-330103
REPORT NO CONF-7605102--(SUMM.)
ABSTRACT THE PLAN FOR ROAD TESTING GAS TURBINES INSTALLED IN FOUR STANDARD INTERCITY GREYHOUND BUSES IS DESCRIBED. THE MAJOR SUBJECTS TO BE INVESTIGATED ARE FUEL ECONOMY AND RELIABILITY. (LCL)
DESCRIPTORS BUSES: T1;FUEL ECONOMY: Q2;GAS TURBINES: T2,Q1;PERFORMANCE TESTING: Q2;RELIABILITY;RESEARCH PROGRAMS

G-110

ACCESSION NO. 79U0066405
REPORT NO.PAGE CONF-7605102--(SUMM PP. 200-212
TITLE CERAMIC RECUPERATIVE HEAT EXCHANGER
AUTHORS KRAUTH, A.
TITLE(MONO) HIGHWAY VEHICLE SYSTEMS: CONTRACTORS COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO 200-212
CONF TITLE HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE TROY, MI, USA
CONF DATE 9 MAY 1976
DATE SEP 1976
CATEGORIES EDB-330103
PRIMARY CAT EDB-330103
REPORT NO CONF-7605102--(SUMM.)
ABSTRACT RESEARCH ON CERAMIC TECHNOLOGY FOR RECUPERATIVE HEAT EXCHANGERS AND GAS TURBINE COMPONENTS IS DISCUSSED. DATA ARE PRESENTED ON THE MECHANICAL STRENGTH, PERMEABILITY, AND THERMAL PROPERTIES OF SIC, SIN, AND ALUMINIUM SILICATE, AND ALUMINUM TITANATE. (LCL)
DESCRIPTORS ALUMINIUM SILICATES: D;AUTOMOBILES: T1,D;CERAMICS;EXPERIMENTAL DATA: D;GAS TURBINES: T2,Q1,D;GRAPHS: D;HEAT EXCHANGERS: T4,Q1; MATERIALS: Q2,Q4;MATERIALS TESTING;MECHANICAL PROPERTIES: D; PERFORMANCE TESTING;PHYSICAL PROPERTIES: D;RESEARCH PROGRAMS; SILICON CARBIDES: D;SILICON NITRIDES: D;TABLES: D;VERY HIGH TEMPERATURE

G-111

ACCESSION NO.	79C0066404
REPORT NO.PAGE	CONF-7605102--(SUMM PP. 190-200
TITLE	ALUMINUM SILICATE HEAT EXCHANGER MATERIALS
AUTHORS	LANNING, J.
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS: CONTRACTORS COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO	190-200
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE	TROY, MI, USA
CONF DATE	9 MAY 1976
DATE	SEP 1976
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-7605102--(SUMM.)
ABSTRACT	THE OBJECTIVE OF THE CORNING PROGRAM IS TO DEVELOP A ROTARY CERAMIC REGENERATOR CORE WHICH WILL MAXIMIZE ITS POTENTIAL FOR: HIGH TEMPERATURE OPERATION; HIGH DURABILITY, HIGH THERMAL EFFICIENCY; LOW COST; AND LOW PRESSURE DROP. THE SCOPE OF THE PROGRAM COVERS MATERIALS DEVELOPMENT, FABRICATION TECHNOLOGY, CELL CONFIGURATION, AND STRUCTURE TESTING. THE DESIGN AND DURABILITY TESTING OF ALUMINUM SILICATE CORES AND FUTURE WORK IN THIS PROGRAM ARE DISCUSSED. (LCL)
DESCRIPTORS	ALUMINIUM SILICATES;AUTOMOBILES;CERAMICS;DESIGN;FABRICATION;GAS TURBINES: T1;MATERIALS: Q2;MATERIALS TESTING;REGENERATORS: T2,Q1;RESEARCH PROGRAMS;VERY HIGH TEMPERATURE

G-112

ACCESSION NO.	79C0066401
REPORT NO.PAGE	CONF-7605102--(SUMM PP. 166-179
TITLE	CURRENT STATUS OF LIFE PREDICTION METHODOLOGY FOR CERAMICS
AUTHORS	LENOE, E.M.
AUTHOR AFF	ARMY MATERIALS AND MECHANICS RESEARCH CENTER, WATERTOWN, MA
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS: CONTRACTORS COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO	166-179
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE	TROY, MI, USA
CONF DATE	9 MAY 1976
DATE	SEP 1976
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-7605102--(SUMM.)
ABSTRACT	FOR THE PAST TWO YEARS, AMMRC HAS CONDUCTED CERAMIC MATERIALS RESEARCH UNDER THE SPONSORSHIP OF DOE-TEC FOR THE GAS TURBINE PROGRAM. THESE STUDIES HAVE INVOLVED GENERAL SUPPORT, AS REQUESTED BY THE DIVISION OF TRANSPORTATION ENERGY CONSERVATION, AND HAVE ALSO FOCUSED ON THREE TASKS: TASK I - DEVELOPMENT OF SINTERABLE SI$SUB 3$N$SUB 4$; TASK II - PROOF TESTING METHODOLOGY; AND TASK III - DURABILITY TESTING OF STRUCTURAL CERAMICS. RECENT ACCOMPLISHMENTS OF TASKS I AND III ARE REVIEWED BRIEFLY AND THE PROGRESS ON TASK II IS PRESENTED.
DESCRIPTORS	AUTOMOBILES: T1;CERAMICS;GAS TURBINES: T2,Q1;MATERIALS: Q2; MATERIALS TESTING;PERFORMANCE TESTING;RESEARCH PROGRAMS: Q4; SILICON NITRIDES: T4;SINTERING: Q4

G-113

ACCESSION NO.	79C0066400
REPORT NO.PAGE	CONF-7605102--(SUMM PP. 163-166
TITLE	AUTOMOTIVE GAS TURBINE CERAMIC MATERIALS PROGRAM OVERVIEW
AUTHORS	BLANKENSHIP, C.P.
AUTHOR AFF	LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS: CONTRACTOR COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO	163-166
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE	TROY, MI, USA
CONF DATE	9 MAY 1976
DATE	SEP 1976
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-7605102--(SUMM.)
ABSTRACT	KEY ELEMENTS IN THE DOE/NASA HEAT ENGINE HIGHWAY VEHICLE SYSTEMS PROJECT INCLUDE IMPROVED AND ADVANCED GAS TURBINE PROPULSION SYSTEMS AND ADVANCED SYSTEM COMPONENT TECHNOLOGY.

CERAMIC MATERIAL TECHNOLOGY DEVELOPMENT IS A MAJOR PROGRAM ELEMENT UNDER THE ADVANCED SYSTEM COMPONENT TECHNOLOGY PORTION OF THE PROJECT. ALL HOT FLOW PATH COMPONENTS IN ADVANCED SYSTEMS ARE EXPECTED TO REQUIRE CERAMIC MATERIALS IN ORDER TO OPERATE AT TURBINE INLET TEMPERATURES NEAR 2500$SUP 0$F. FOR CERAMIC COMPONENTS, FABRICATION TECHNOLOGY IS A KEY AREA OF DEVELOPMENT THAT WILL REQUIRE SUBSTANTIAL EFFORTS FOR COMPONENTS SUCH AS ROTORS AND HEAT EXCHANGERS. COMPONENT RELIABILITY AND COST-EFFECTIVENESS WILL BE EMPHASIZED AS THEY ARE THE MOST IMPORTANT FACTORS IN THE APPLICATION OF CERAMICS TO AUTOMOTIVE SYSTEMS. THE STRUCTURE OF THE CERAMIC MATERIALS PROGRAM COVERS: MATERIALS CHARACTERIZATION; IMPROVED MATERIALS DEVELOPMENT; AND COMPONENT DEVELOPMENT. THE STATUS OF RESEARCH STUDIES IN EACH OF THESE FIELDS IS REVIEWED.

DESCRIPTORS — AUTOMOBILES: T1;CERAMICS;FABRICATION;GAS TURBINES: T2,G1;HOT PRESSING;MATERIALS: Q2;RESEARCH PROGRAMS: G2;SILICON CARBIDES; SILICON NITRIDES;SINTERING;US DOE;VERY HIGH TEMPERATURE

G-114

ACCESSION NO. — 79U0088399
REPORT NO.PAGE — CONF-7805102--(SUMM PP. 156-162
TITLE — STATUS OF FORD CERAMIC REGENERATOR SYSTEM DEVELOPMENT PROGRAM
AUTHORS — RAHNKE, C.J.
TITLE(MONO) — HIGHWAY VEHICLE SYSTEMS: CONTRACTOR COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO — 156-162
CONF TITLE — HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE — TROY, MI, USA
CONF DATE — 9 MAY 1978
DATE — SEP 1978
CATEGORIES — EDB-330103
PRIMARY CAT — EDB-330103
REPORT NO — CONF-7805102--(SUMM.)
ABSTRACT — DATA ACCUMULATED IN THE LAST SIX MONTHS IN THE PROGRAM FOR EVALUATING CERAMIC REGENERATORS FOR VEHICULAR GAS TURBINES CONTINUES TO SHOW THAT TWO MATERIALS, ALUMINUM SILICATE (AS) AND MAGNESIUM ALUMINUM SILICATE (MAS), HAVE THE POTENTIAL OF ACHIEVING THE PROGRAM OBJECTIVE OF A B$SUB 10$ LIFE OF 10,000 H AT 800$SUP 0$C. TO DATE, NONE OF THE EIGHTEEN AS OR SIX MAS CORES THAT HAVE BEEN ENGINE TESTED SHOW ANY SERIOUS SIGNS OF CHEMICAL ATTACK DAMAGE. TWO AS CORES HAVE EACH ACCUMULATED OVER 7000 H. A PROBLEM STILL EXISTS IN ELASTOMERICALLY BONDING A RING GEAR TO A THIN-WALL AS CORE. ONE THIN-WALL CORE WITH A HIGH COMPLIANCE ELASTOMER DESIGN HAS ACCUMULATED 4000 H WITHOUT DISTRESS, BUT A BIGGER SAMPLE IS NEEDED BEFORE ANY CONCLUSION CAN BE REACHED. A THICK-WALL AS CORE HAS NOW ACCUMULATED 5000 H AT 982$SUP 0$C WITHOUT DAMAGE. FULL-SIZE, SECOND GENERATION MAS CORES, OF IMPROVED MATERIAL COMPOSITION, ARE NOW ON ENGINE TEST. OTHER NEW MATERIALS ARE NOW UNDERGOING LABORATORY AND ENGINE SCREENING TESTS FOR CHEMICAL ATTACK RESISTANCE AND ELEVATED TEMPERATURE CAPABILITY.
DESCRIPTORS — ALUMINIUM SILICATES;AUTOMOBILES: T1;CERAMICS: D;CORROSION: Q3; EXPERIMENTAL DATA: D;GAS TURBINES: T2,Q1;GRAPHS: D;MAGNESIUM COMPOUNDS;MATERIALS: Q3;MATERIALS TESTING: D;PERFORMANCE TESTING: Q3,D;REGENERATORS: T3,Q2,D;TABLES: D;VERY HIGH TEMPERATURE

G-115

ACCESSION NO. — 79C0088396
REPORT NO.PAGE — CONF-7805102--(SUMM PP. 133-155
TITLE — PROCESSING TECHNOLOGY AND EVALUATION OF DUO-DENSITY CERAMIC TURBINE ROTORS
AUTHORS — BAKER, R.R.
TITLE(MONO) — HIGHWAY VEHICLE SYSTEMS: CONTRACTOR COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO — 133-155
CONF TITLE — HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE — TROY, MI, USA
CONF DATE — 9 MAY 1978
DATE — SEP 1978
CATEGORIES — EDB-330103;360200
PRIMARY CAT — EDB-330103
REPORT NO — CONF-7805102--(SUMM.)
ABSTRACT — DUO-DENSITY SILICON NITRIDE ROTORS FOR VEHICULAR GAS TURBINES

	FABRICATED IN 1977, BY A PROCESS DEVELOPED PARTIALLY UNDER DOE FUNDING, HAVE SHOWN A SIGNIFICANT IMPROVEMENT IN COLD SPIN RELIABILITY OVER THE STATE-OF-THE-ART ROTORS FABRICATED IN 1975. HOT TEST RESULTS (OF 1977 VINTAGE ROTORS) IN BOTH HOT SPIN RIGS AND ENGINES ARE VERY ENCOURAGING IN THAT THE FIRST ATTEMPT TO COMPLETE A 200-H ROTOR DURABILITY TEST WAS SUCCESSFUL. CERAMIC TURBINE ROTORS HAVE NOW BEEN RUN AT TURBINE INLET TEMPERATURES OF 2000 TO 2500$SUP 0$F AT SPEEDS OF 27,000 TO 50,000 RPM FOR PERIODS UP TO 200 H. PROCESS IMPROVEMENTS IN INJECTION MOLDING WERE IDENTIFIED WITH THE ADDITION OF A HUNKAR FLOW CONTROL UNIT WHICH RESULTED IN ELIMINATING SUBSURFACE VOIDS IN THE INNER, MORE HIGHLY STRESSED PORTION OF THE BLADES. MICROFOCUS X-RAY TECHNIQUES WERE DEVELOPED TO PRODUCE MAGNIFIED X-RAYS IN ADDITION TO RADIAL VIEW PANORAMIC X-RAYS OF THE ROTOR BLADE RING RIM. DEGRADATION OF REACTION-BONDED SILICON NITRIDE BLADE RINGS, WHICH OCCURRED DURING HOT PRESS BONDING, WAS FOUND TO BE CONTROLLABLE. THE ALL-CERAMIC TURBINE ROTOR HAS NOW JOINED THE CERAMIC STATIONARY COMPONENTS WHICH PREVIOUSLY HAD DEMONSTRATED 200 H DURABILITY. A MAJOR INTEGRATED PROGRAM IS NOW NEEDED TO DESIGN AND DEMONSTRATE HIGH EFFICIENCY CERAMIC TURBINES AND TO DEVELOP CERAMIC MATERIALS AND PROCESSES FOR LONG DURABILITY AND HIGH RELIABILITY.
DESCRIPTORS	AUTOMOBILES: T1;CERAMICS;DEFECTS;FABRICATION: 03;FAILURES;GAS TURBINES: T2,01;HOT PRESSING;MATERIALS: 03;MATERIALS TESTING; PERFORMANCE TESTING: 03;ROTORS: T3,02;SILICON NITRIDES;TEST FACILITIES;VERY HIGH TEMPERATURE

G-116

ACCESSION NO.	79U0086395
REPORT NO,PAGE	CONF-7605102--(SUMM PP. 83-92
TITLE	IN-HOUSE TEST PROGRAM ON TURBOMACHINERY COMPONENTS AT NASA LEWIS RESEARCH CENTER
AUTHORS	WONG, R.Y.
AUTHOR AFF	LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS: CONTRACTORS COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO	83-92
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE	TROY, MI, USA
CONF DATE	9 MAY 1978
DATE	SEP 1978
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-7605102--(SUMM.)
ABSTRACT	THE OBJECTIVE OF THIS PROGRAM IS TO SUPPORT THE UPGRADED ENGINE DEVELOPMENT PROGRAM BY PROVIDING: AERODYNAMIC COMPONENTS WHICH HAVE THE POTENTIAL TO MEET PERFORMANCE GOALS AND AUTOMOTIVE RELATED CONSTRAINTS, SUCH AS DRIVEABILITY, LOW COST FABRICATION, ETC.; AND COMPONENT TEST DATA THAT CAN BE USED IN DIAGNOSING ENGINE PERFORMANCE PROBLEMS. THE SCOPE OF THIS EFFORT IS TO BUILD COMPONENT TEST RIGS AND MAKE COMPONENT TESTS OF EACH COMPONENT. THESE COMPONENTS INCLUDE THE COMPRESSOR, COMPRESSOR DRIVE TURBINE, POWER TURBINE, INTERSTAGE DUCTING, AND DOWNSTREAM DIFFUSER ALL PROVIDED FROM THE CHRYSLER UPGRADED ENGINE PROGRAM. THE RESULTS OF TESTS ON THE COMPRESSOR AND COMPRESSOR DRIVE TURBINE ARE PRESENTED.
DESCRIPTORS	AUTOMOBILES: T1;COMPRESSORS: T3;EXPERIMENTAL DATA: D;GAS TURBINES: T2,01,D;GRAPHS: D;PERFORMANCE;PERFORMANCE TESTING: 02,D;RESEARCH PROGRAMS: 02,03;TEST FACILITIES;TURBOMACHINERY

G-117

ACCESSION NO.	79U0068393
REPORT NO,PAGE	CONF-7805102--(SUMM PP. 46-66
TITLE	STATUS OF CERAMIC COMPONENT AND DURABILITY DEVELOPMENT FOR THE GAS TURBINE ENGINE
AUTHORS	ROCKWOOD, F.A.
AUTHOR AFF	GENERAL MOTORS CORP., DETROIT, MI
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS: CONTRACTORS COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO	46-66
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE	TROY, MI, USA
CONF DATE	9 MAY 1978
DATE	SEP 1978

CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-7605102--(SUMM.)
ABSTRACT	CURRENT ACTIVITIES IN A PROGRAM TO DEVELOP AND EVALUATE CERAMIC COMPONENTS FOR VEHICULAR GAS TURBINE ENGINES ARE REVIEWED. AT THIS POINT IN THE PROGRAM, ENGINE TESTING HAS RESULTED IN OVER 1000 H ON SILICON CARBIDE NOZZLE VANES, 102 H ON A SILICON NITRIDE TIP SHROUD, AND OVER 3000 H ON ALUMINUM SILICATE REGENERATOR DISKS AT AN ENGINE OPERATING TEMPERATURE OF 1900$SUP 0$F. IN ADDITION, INITIAL MATERIALS CHARACTERIZATION IS BEING CONDUCTED ON REACTION-BONDED SILICON CARBIDE, SINTERED SILICON CARBIDE, REACTION-BONDED SILICON NITRIDE, AND SINTERED SILICON NITRIDE. COMPONENTS OF ALTERNATIVE MATERIALS FOR THE VANE AND TIP SHROUD ARE NOW UNDERGOING RIG COMPONENT TESTS IN PREPARATION FOR EARLY ENGINE EVALUATION. DURING THE NEXT REPORT PERIOD, EMPHASIS WILL BE ON CONTINUED TESTING AT 1900$SUP 0$F WHILE DESIGN AND PROCESS DEVELOPMENT ACTIVITIES FOR THE 2070$SUP 0$F CONFIGURATION ARE CONDUCTED.
DESCRIPTORS	ALUMINIUM SILICATES;AUTOMOBILES: T1;CERAMICS;EXPERIMENTAL DATA: D;GAS TURBINES: T2,01,D;GRAPHS: D;MATERIALS: 02,D;MATERIALS TESTING;PERFORMANCE TESTING;RESEARCH PROGRAMS: 02;SILICON CARBIDES;SILICON NITRIDES;VERY HIGH TEMPERATURE

G-118

ACCESSION NO.	79C0066392
REPORT NO,PAGE	CONF-7605102--(SUMM PP. 22-46
TITLE	STATUS OF CORRECTIVE DEVELOPMENT PROGRAM ON CHRYSLER UPGRADED ENGINE
AUTHORS	WAGNER, C.E.
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS: CONTRACTORS COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO	22-46
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE	TROY, MI, USA
CONF DATE	9 MAY 1976
DATE	SEP 1976
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	CONF-7605102--(SUMM.)
ABSTRACT	SINCE 1973 THE CHRYSLER CORP. HAS BEEN ENGAGED IN A PROGRAM TO UPGRADE ITS AUTOMOBILE GAS TURBINE. THE FIRST UPGRADED ENGINE WAS PERFORMANCE TESTED IN JULY 1976 AND THE RESULTS SHOWED THAT THE TURBOMACHINERY SECTION WOULD HAVE TO BE REDESIGNED TO MEET PROGRAM GOALS. PROGRESS IS REPORTED ON THE CORRECTIVE DEVELOPMENT PHASE OF THIS PROGRAM WHICH INVOLVES COMPRESSOR DEVELOPMENT, POWER TURBINE REDESIGN, TURBINE SECTION REDESIGN, COMPRESSOR TURBINE DEVELOPMENT, THRUST BEARING AND GAS BEARING DEVELOPMENT, AND ENGINE--VEHICLE SYSTEM DEVELOPMENT. (LCL)
DESCRIPTORS	AUTOMOBILES: T1;GAS TURBINES: T2,01;RESEARCH PROGRAMS: 02

G-119

ACCESSION NO.	79X0067692
TITLE(MONO)	ADVANCED COAL-FUELED COMBUSTOR/HEAT EXCHANGER TECHNOLOGY STUDY. FINAL REPORT, MARCH 1977--JUNE 1978
CORPORATE AUTH	ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA (USA). ROCKETDYNE DIV.
PAGE NO	42
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EF-77-C-01-2612
DATE	1978
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
REPORT NO	RI/RD--78-212
ABSTRACT	THIS REPORT DISCUSSES THE DESIGN OF COAL-FIRED COMBUSTOR/HEAT EXCHANGERS SUITABLE FOR INPUTING THE HEAT TO BASE-LOADED, CLOSED-CYCLE, GAS TURBINE, 350 MWE, CENTRAL STATION POWER GENERATION SYSTEMS. A WIDE VARIETY OF CCGT CYCLES ARE EVALUATED TO ESTABLISH THE PERFORMANCE REQUIREMENTS FOR THE COMBUSTOR/HEAT EXCHANGER. THE CYCLES FINALLY SELECTED FOR COMBUSTOR/HEAT EXCHANGER DESIGN OPERATE AT 1550 F, 1750 F, AND 2250 F MAXIMUM WORKING-FLUID TEMPERATURES. EACH SELECTED CYCLE

IS BOTTOMED WITH A RANKINE/STEAM CYCLE OPERATING AT 2400 PSI/1050 F/1050 F. THE COAL INPUTS TO STATIONS INCORPORATING THE SELECTED ANGLES ARE ESTIMATED TO RANGE BETWEEN 82 AND 88% OF THE REQUIRED INPUT TO A 2400-PSI/1000 F/1000 F CONVENTIONAL STEAM STATION. AT THE 1550 F MAXIMUM WORKING-FLUID TEMPERATURE, TWO COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGNS ARE CREATED, ONE UTILIZING THE PULVERIZED-COAL-FIRED, DRY-BOTTOM FURNACE FIRING CONCEPT AND THE OTHER UTILIZING THE ATMOSPHERIC-PRESSURE, FLUIDIZED BED WITH LIMESTONE ADDITION FIRING CONCEPT. IN BOTH DESIGNS, ALL HEAT EXCHANGER SURFACE IS METAL. AT THE 1750 F MAXIMUM WORKING-FLUID TEMPERATURE, THE COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGN IS BASED ON A SERIES ARRANGEMENT OF HIGH- AND LOW-TEMPERATURE FLUIDIZED BEDS. AT 2250 F MAXIMUM WORKING-FLUID TEMPERATURE, THE COMBUSTOR/HEAT EXCHANGER PRELIMINARY DESIGN IS BASED ON THE SLAGGING CYCLONE COMBUSTOR CONCEPT. HEAT EXCHANGER SURFACE EXPOSED TO WORKING-FLUID TEMPERATURES ABOVE 1550 F IS CONSTRUCTED OF SILICON CARBIDE. THE KEY TECHNICAL FEATURES OF THE FOUR PRELIMINARY DESIGNS AREIDENTIFIED AND ANALYZED. RESEARCH AND DEVELOPMENT PROGRAMS TO ADVANCE THE TECHNOLOGY OF THESE DESIGNS TO A STATE OF READINESS FOR COMMERCIAL APPLICATION ARE OUTLINED, AND R AND D COST ESTIMATES ARE PRESENTED. THE COST OF ELECTRICITY PRODUCED IN 700 MWE STATIONS INCORPORATINC THE STUDIED CCGT CYCLES AND COMBUSTOR/HEAT EXCHANGERS IS ESTIMATED AND COMPARED WITH THE COST OF ELECTRICITY IN CONVENTIONAL STEAM STATIONS.

DESCRIPTORS: CARBON DIOXIDE;CLOSED-CYCLE SYSTEMS;COMBINED-CYCLE POWER PLANTS: T1;COMBUSTORS: T3.Q1;COMPARATIVE EVALUATIONS;COST; DESIGN: Q2.Q3;GAS TURBINES;HEAT EXCHANGERS: T2.Q1;HELIUM; MATERIALS;POWER GENERATION;STEAM TURBINES;THERMODYNAMIC CYCLES; WORKING FLUIDS: Q2

G-120

ACCESSION NO. 79X0064513
TITLE(MONO) HOT CORROSION/EROSION TESTING OF MATERIALS FOR APPLICATION TO ADVANCED POWER CONVERSION SYSTEMS USING COAL-DERIVED FUELS. TASK II: FLUIDIZED BED COMBUSTION. MONTHLY TECHNICAL REPORT, SEPTEMBER 1--30, 1977
EDITOR OR COMP NUTKIS, M.S.; BERTRAND, G.; LOUGHNANE, M.D.
CORPORATE AUTH EXXON RESEARCH AND ENGINEERING CO., LINDEN, NJ (USA). GOVERNMENT RESEARCH LAB.
PAGE NO 16
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT EX-76-C-01-2452
DATE 6 OCT 1977
CATEGORIES EDB-421000;014000
PRIMARY CAT EDB-421000
REPORT NO FE--2452-15
ABSTRACT THREE TESTS OF THE MINIPLANT GRANULAR BED FILTER WERE ACCOMPLISHED. MODIFICATIONS TO THE GRANULAR BED FILTER INVOLVED THE ADDITION OF METHANE INJECTION, OUTLET PIPING MANIFOLDS, AND INSULATION. GRANULAR BED FILTER EXIT TEMPERATURES OF 1550$SUP 0$F WERE ATTAINED FOR SHORT INTERVALS.
DESCRIPTORS COAL;FLUIDIZED-BED COMBUSTION;FLUIDIZED-BED COMBUSTORS: T2;GAS TURBINES: T4,Q2;GRANULAR BED FILTERS: T1;HEAT EXCHANGERS: T3.Q2; MATERIALS: Q3,Q4;MODIFICATIONS: Q1;PERFORMANCE TESTING: Q1

G-121

ACCESSION NO. 79J0061657
TITLE WHAT GAS-TURBINE MAINTENANCE TOOLS
AUTHORS LUNDBERG, L.
AUTHOR AFF B.K. SWEENEY MANUF CO
PUB DESC POWER (N.Y.), V. 122, NO. 10, PP. 47-48
DATE OCT 1978
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT GAS-TURBINE PREVENTIVE MAINTENANCE PROGRAMS CAN SUCCESSFULLY REDUCE DOWNTIME, INCREASE EFFICIENCY, AND LOWER EMISSIONS. TO ACHIEVE THESE AIMS, AND GUARANTEE THE SAFETY OF MECHANICS, THE USE OF SOME SPECIALIZED TOOLS IS RECOMMENDED. IN PARTICULAR THE USE OF TORQUE MULTIPLIERS, PULLERS AND PUSHERS, SOCKETS AND TRANSPORT STANDS IS DESCRIBED.
DESCRIPTORS GAS TURBINES: T1;MAINTENANCE: Q1

G-122

ACCESSION NO	79R0076194
TITLE(MONO)	BRITTLE MATERIALS DESIGN, HIGH-TEMPERATURE GAS TURBINE: CERAMIC TURBINE ROTOR TECHNOLOGY. INTERIM REPORT NO. 13, OCTOBER 1977--MARCH 1978
EDITOR OR COMP	MCLEAN, A.F.; BAKER, R.R.
CORPORATE AUTH	FORD MOTOR CO., DEARBORN, MI (USA)
PAGE NO	106
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2630
DATE	FEB 1979
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	AMMRC-TR--79-11
ABSTRACT	PROGRESS OF PREVIOUS WORK ON REACTION BONDED AND HOT PRESSED SILICON NITRIDE MATERIALS TECHNOLOGY IS SUMMARIZED. IMPROVEMENTS TO THE HOT PRESS BONDING PROCESS RESULTED IN A SIGNIFICANT IMPROVEMENT IN THE YIELD OF FLAW-FREE HOT PRESS BONDED ROTORS. MODULUS OF RUPTURE AND COLD SPIN TESTS OF ROTOR BLADE RINGS REVEALED THE PRESENCE OF UNDETECTED SUBSURFACE FLAWS IN BOTH THE BLADES AND THE RIM. BLADE BEND TESTING INDICATED THAT BLADE STRENGTH DEGRADED DURING HOT PRESS BONDING. AN INVESTIGATION OF HOT PRESS BONDING TEMPERATURES AND TIME AT TEMPERATURE DEFINED A REGION OF ZERO MICROSTRUCTURAL AND STRENGTH DEGRADATION. USING 19 HOT PRESS BONDINGS, CURVES WERE GENERATED DEFINING THE CHANGES IN COLOR, POROSITY, HARDNESS, PHASE AND STRENGTH AS A FUNCTION OF TIME AND TEMPERATURE. IMPROVEMENTS IN INJECTION MOLDING OF ROTOR BLADE RINGS WERE MADE UTILIZING AN ADAPTIVE PROCESS CONTROL UNIT WHICH CONTROLLED AND MONITORED THE INJECTION VELOCITY AND DIE CAVITY PRESSURE DURING THE INJECTION AND HOLD PORTIONS OF THE MOLDING CYCLE. MICROFOCUS X-RAY RESULTS INDICATED THAT HIGH INJECTION FLOWRATES COMBINED WITH LOW HOLDING PRESSURES IN THE DIE CAVITY REDUCED THE NUMBER OF SUBSURFACE VOID-TYPE BLADE FLAWS. THE DETECTION OF PLANAR FLAWS IN BOTH GREEN AS-MOLDED AND NITRIDED BLADE RINGS REVEALED THAT THIS TYPE FLAW WAS ONLY DETECTABLE AFTER NITRIDING, INDICATING THAT IT MAY ONLY OCCUR AFTER BURN OUT AND/OR NITRIDING. APPROXIMATELY 30 EXPERIMENTS WERE CONDUCTED UTILIZING GLASS AND/OR METALS AS ISOSTATIC HOT PRESSING MEDIA. DECOMPOSITION OF THE GLASS WAS MINIMIZED WITH VYCOR UTILIZING BORON NITRIDE AS A BARRIER MATERIAL. A RELIABILITY ANALYSIS WAS CONDUCTED FOR INDIVIDUAL LOADING CONDITIONS. RECOMMENDATIONS FOR FOLLOW ON WORK ARE PRESENTED.
DESCRIPTORS	AUTOMOBILES;BONDING;CERAMICS;DEFECTS;FABRICATION: Q2;GAS TURBINES: T1;HOT PRESSING;MATERIALS TESTING: Q3;PERFORMANCE TESTING: Q2;RELIABILITY;RESEARCH PROGRAMS: Q2,Q3,Q4;ROTORS: T2,Q1;SILICON CARBIDES;SILICON NITRIDES: T3;TURBINE BLADES: T4;VERY HIGH TEMPERATURE

G-123

ACCESSION NO.	79R0076192
TITLE(MONO)	TECHNICAL OVERVIEW OF COGENERATION: THE HARDWARE, THE INDUSTRIES, THE POTENTIAL DEVELOPMENT
CORPORATE AUTH	RESOURCE PLANNING ASSOCIATES, INC., WASHINGTON, DC (USA)
PAGE NO	87
AVAILABILITY	DEP. NTIS, PC A05/MF A01.
CONTRACT NO	CONTRACT EY-76-C-03-1223-009;EY-76-C-03-1223-016
DATE	1 DEC 1977
DROP NOTE	PORTIONS OF DOCUMENT ARE ILLEGIBLE
CATEGORIES	EDB-320603;290600
PRIMARY CAT	EDB-320603
REPORT NO	SAN--1223-T1
ABSTRACT	BECAUSE THE BY-PRODUCT HEAT FROM A POWER-CONVERSION PROCESS IS CAPTURED FOR PRODUCTIVE USE IN A COGENERATION SYSTEM, INSTEAD OF EXHAUSTED TO THE ENVIRONMENT AS IT IS IN A CONVENTIONAL POWER PLANT, COGENERATION REPRESENTS AN IMPORTANT ENERGY-CONSERVATION TECHNIQUE. BY COGENERATING, AN INDUSTRIAL PLANT CAN SAVE THE FUEL THAT WOULD HAVE BEEN NEEDED TO PRODUCE THE AMOUNT OF HEAT CAPTURED. RECOGNIZING THE SIGNIFICANT ENERGY-SAVINGS POTENTIAL OFFERED BY COGENERATION, DOE HAS UNDERTAKEN A MAJOR R, D, AND D PROGRAM TO INVESTIGATE AND PROMOTE COGENERATION IN INDUSTRY. RESOURCE PLANNING ASSOCIATES, INC. (RPA), HAS BEEN WORKING TO ACCOMPLISH FOUR OF THE PROGRAM'S OBJECTIVES: (1) SURVEY CURRENT, NEAR STATE-OF-THE-ART, AND FUTURE COGENERATION EQUIPMENT, AND IDENTIFY ANY GAPS OR DEFICIENCIES; (2) CHARACTERIZE THE ENERGY REQUIREMENTS OF THE MANUFACTURING SECTORS OF FIVE OF THE COUNTRY'S MOST ENERGY-INTENSIVE INDUSTRIES - CHEMICAL, PETROLEUM REFINING, PAPER AND PULP, TEXTILES, AND FOOD; (3) IDENTIFY PRINCIPAL TARGETS FOR, AND BARRIERS TO, THE INCREASED

MARKET DEVELOPMENT OF COGENERATION SYSTEMS; AND (4) ESTIMATE THE POTENTIAL MAXIMUM AND THE PROBABLE ENERGY SAVINGS THAT COULD BE ACHIEVED IN THE FIVE SELECTED INDUSTRIES THROUGH COGENERATION. IN INVESTIGATING COGENERATION HARDWARE, THREE SPECIFIC TECHNOLOGIES - STEAM TURBINES, GAS TURBINES, AND DIESEL ENGINES - WERE EMPHASIZED. IT IS ESTIMATED THAT THE WIDESPREAD APPLICATION OF COGENERATION TECHNOLOGY IN THE FIVE INDUSTRIES STUDIED COULD RESULT IN A MAXIMUM POTENTIAL SAVINGS OF 2.4 MILLION BARRELS OF OIL EQUIVALENT PER DAY (OR A MAXIMUM INCREMENTAL CAPACITY OF 140,000 MWE) BY 1985.

DESCRIPTORS: CHEMICAL INDUSTRY: T4;CO-GENERATION: T6,Q1,Q2,Q3,Q4,Q5; DEMONSTRATION PROGRAMS;DIESEL ENGINES;ECONOMIC IMPACT;ENERGY CONSERVATION;ENERGY SUBSTITUTION EQUIVALENT;FOOD INDUSTRY: T5; GAS TURBINES;GOVERNMENT POLICIES;INDUSTRY;LEGAL ASPECTS;PAPER INDUSTRY: T2;PETROLEUM REFINERIES: T1;REVIEWS: Q6;STEAM TURBINES;TEXTILE INDUSTRY: T3;US DOE

G-124

ACCESSION NO. 79J0072711
TITLE CHANGING WORLD OF GAS TURBINES
AUTHORS JAVETSKI, J.
PUB DESC POWER (N.Y.), V. 122, NO. 9, P. S
DATE SEP 1978
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT THE LAST DECADE HAS WROUGHT MANY CHANGES--SHORTAGES AND SKYROCKETING PRICES OF FUEL, AND GREATER CONCERN FOR THE ENVIRONMENT, TO NAME JUST TWO--THAT HAVE THREATENED THE FUTURE VIABILITY OF THE GAS TURBINE. THIS SPECIAL REPORT DETAILS THE EFFECTS THAT THESE CHANGES HAVE HAD ON GAS-TURBINE DESIGN, DESIGN IMPROVEMENTS, FUELS FLEXIBILITY, AND ENVIRONMENTAL COMPATIBILITY. THE THERMODYNAMICS, COMPONENTS AND APPLICATIONS OF GAS TURBINES, RECENT DESIGN IMPROVEMENTS AIMING FOR EFFICIENCY AND RELIABILITY, AND THE PROBLEM OF FUELS ARE CONSIDERED. IMPROVED DESIGNS MAKE POSSIBLE HIGHER TURBINE-INLET TEMPERATURES AND COMPRESSION RATIO. ALSO BETTER COOLING TECHNIQUES, BETTER MATERIALS AND COATINGS ARE INTRODUCED. THE PROBLEM OF COPING WITH THE NEW EXHAUST-EMISSION LIMITS IS THEN DISCUSSED. FUTURE IMPROVEMENTS MAY INCLUDE HIGHER FIRING TEMPERATURES, GREATER USE OF COAL AS FUEL, AND HOMOGENIZATION OF GAS-TURBINE FUEL AND WATER TO REDUCE EMISSIONS.
DESCRIPTORS AIR POLLUTION CONTROL;DESIGN: Q1;EFFICIENCY;GAS TURBINES: T1; PERFORMANCE: Q1;RELIABILITY

G-125

ACCESSION NO. 79J0072710
TITLE CALIBRATION AND TROUBLESHOOTING OF GAS TURBINE CONTROLS
AUTHORS STRETCH, R.J.; SHINN, J.N.; BRUDOS, D.B.
AUTHOR AFF GE
PUB DESC POWER ENG., V. 82, NO. 11, PP. 66-69
DATE NOV 1978
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT DURING THE INITIAL INSTALLATION OF A GAS TURBINE PLANT, THE TOTAL CONTROL SYSTEM IS CALIBRATED AND TESTED TO VERIFY PROPER PERFORMANCE PRIOR TO COMMERCIAL OPERATION. AFTER THE UNIT IS IN SERVICE, THE CALIBRATION SHOULD BE CHECKD ON A PERIODIC BASIS AS RECOMMENDED BY THE MANUFACATURER OR AS EXPERIENCE DICTATES. ALTHOUGH MOST OF THE CALIBRATING POINTS ARE ELECTRONIC ADJUSTMENTS IN THE TURBINE PANEL, THERE ARE ADDITIONAL DEVICES ON THE TURBINE BASE (AND SOME IN OTHER OFF-BASE EQUIPMENT) WHICH REQUIRE CALIBRATION OR A SETINGS CHECK TAO COMPLETE A MACHINE CALIBRATION. THESE DEVICES TYPICALLY INCLUDE PRESSURE TRANSDUCERS, PRESSURE SWITCHES, AND TEMPERATURE SWITCHES. CALIBRATION CHECKING OF THESE DEVICES IS SOMEWHAT MORE TROUBLESOME THAN THE CALIBRATION OF THE ELECTRONICS BECAUSE, GENERALLY, THEY MUST BE ISOLATED FROM THE SYSTEM BEFORE A CHECK CAN BE MADE.
DESCRIPTORS CALIBRATION;CONTROL SYSTEMS: Q1;ELECTRONIC EQUIPMENT;GAS TURBINES: T1,Q3;MAINTENANCE;POWER PLANTS: T3;RELIABILITY

G-126

ACCESSION NO. 79J0072707
TITLE HOW LIGHTWEIGHT AND HEAVY GAS TURBINES COMPARE
AUTHORS GIAMPAULO, A.J.
AUTHOR AFF COOPER ENERGY SERV, MOUNT VERNON, OHIO
PUB DESC OIL GAS J., V. 77, NO. 1, PP. 65-66, 73
DATE 1 JAN 1979
CATEGORIES EDB-200104;330103
PRIMARY CAT EDB-200104
ABSTRACT INDUSTRIAL, MARINE, POWER GENERATION, AND PUMPING APPLICATIONS HAVE DEMONSTRATED THAT LIGHTWEIGHT AND HEAVYWEIGHT GAS TURBINES ARE BOTH SUITED FOR HEAVY-DUTY BASE LOAD OPERATIONS. THE TERM LIGHTWEIGHT REFERS TO AERO-DERIVATIVE GAS TURBINES. THE AUTHOR FIRST OFFERS A BRIEF HISTORICAL REVIEW OF GAS-TURBINE ADVANCES, AND THEN DISCUSSES THE CURRENT SIMILARITIES BETWEEN THE LIGHTWEIGHT AND HEAVYWEIGHT GAS TURBINES. DESIGN VARIATIONS BETWEEN THE TWO GAS TURBINES ARE ALSO COVERED.
DESCRIPTORS BEARINGS;COMBUSTORS;COMPARATIVE EVALUATIONS: Q1;COMPRESSORS; EFFICIENCY;GAS TURBINES: T1;OPERATION;PETROLEUM;PIPELINES

G-127

ACCESSION NO. 79J0066072
TITLE GAS TURBINES IN PEAK AND BASE-LOAD OPERATION
AUTHORS GARD, M.
PUB DESC AEG-TELEFUNKEN PROG., NO. 3, PP. 104-109
DATE 1976
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT THIS ARTICLE GIVES SOME OF THE CHARACTERISTIC DATA OF AEG-KANIS GAS TURBINES. DETAILED INFORMATION ON EFFICIENCIES AND SPECIFIC COSTS PROVIDES THE BASIS FOR DISCUSSION OF THE ECONOMICS OF VARIOUS TYPES OF OPERATION, TAKING FUEL AVAILABILITY AND CURRENT PRICES INTO ACCOUNT. FINALLY, THE INFLUENCE OF GAS TURBINE OPERATION ON THE ENVIRONMENT IS BRIEFLY DISCUSSED.
DESCRIPTORS COST;EFFICIENCY: Q1;GAS TURBINES: T1;HEAT RECOVERY;LOAD MANAGEMENT: Q1;OPERATION;START-UP;TEMPERATURE DEPENDENCE; THERMODYNAMIC CYCLES

G-128

ACCESSION NO. 79J0063282
TITLE STATUS OF CERAMIC APPLICATIONS IN TURBINE ENGINES
AUTHORS ROCKWOOD, F.A.
AUTHOR AFF DETROIT DIESEL ALLISON, INDIANAPOLIS, INDIANA
PUB DESC SAE PREPR., NO. 760701, PP. 1-11
DATE 1976
CATEGORIES EDB-330103;360203
PRIMARY CAT EDB-330103
ABSTRACT AS PART OF THE DEPARTMENT OF ENERGY ACTIVITIES TO REDUCE PETROLEUM CONSUMPTION, DETROIT DIESEL ALLISON (DDA) IS CONDUCTING A PROGRAM AIMED AT ADVANCING THE STATE-OF-THE-ART OF UTILIZATION OF CERAMIC COMPONENTS IN HIGHWAY VEHICLE GAS TURBINE ENGINES TO REDUCE FUEL CONSUMPTION BY PERMITTING INCREASED GAS TURBINE OPERATING TEMPERATURES. INITIAL COMPONENTS AND ENGINE TESTS OF THREE COMPONENTS ARE UNDERWAY AT AN ENGINE OPERATING TEMPERATURE 65$SUP 0$F (16$SUP 0$C) ABOVE THE BASELINE ALL-METAL DDA 404 INDUSTRIAL GAS TURBINE ENGINE. ENGINE EXPERIENCE TOTALS OVER 1000 H ON A SET OF SILICON CARBIDE NOZZLE VANES, 100 H ON A SILICON NITRIDE TIP SHROUD AND 3000 H ON ALUMINUM SILICATE REGENERATORS.
DESCRIPTORS ALUMINIUM SILICATES;AUTOMOBILES: T2;CERAMICS;FUEL CONSUMPTION; GAS TURBINES: T1,Q2;INTERNAL COMBUSTION ENGINES;MATERIALS: Q1; MATERIALS TESTING;SILICON CARBIDES;SILICON NITRIDES;TEMPERATURE EFFECTS;USES

G-129

ACCESSION NO. 79J0063281
TITLE DEPARTMENT OF ENERGY AUTOMOTIVE HEAT ENGINE PROGRAM
AUTHORS THUR, G.M.
AUTHOR AFF US DEP OF ENERGY
PUB DESC SAE PREPR., NO. 780696, PP. 1-11
DATE 197[illegible]
CATEGORIES EDB-330103;330201;330603
PRIMARY CAT EDB-330103
ABSTRACT FOR SOME TIME NOW, THE DEPARTMENT OF ENERGY (DOE) HAS BEEN INVOLVED IN THE DEVELOPMENT OF NEW HEAT ENGINE SYSTEMS TO POWER CARS, BUSES, AND TRUCKS. THIS PAPER PRESENTS HOW THE AUTHOR VIEWS THE MAJOR ISSUES AFFECTING ADVANCED AUTOMOTIVE PROPULSION SYSTEMS. IN ADDITION, THE ROLES OF INDUSTRY AND GOVERNMENT ARE DESCRIBED. GOALS AND OBJECTIVES FOR THE DOE HEAT ENGINE PROGRAM ARE DEFINED, AND HOW DOE PLANS TO MEET THESE GOALS IS DISCUSSED. LASTLY, A MARKET PROJECTION IS PRESENTED THAT SHOWS HOW AND WHEN THESE ADVANCED HEAT ENGINE TECHNOLOGIES COULD REACH THE CONSUMER. THE CURRENT PROGRAM OBJECTIVES ARE TO DEMONSTRATE IN AUTOMOBILES BY 1983: AT LEAST A 30 PERCENT IMPROVEMENT IN FUEL ECONOMY COMPARED TO THE BEST ICE SYSTEM DESIGN FOR THE SAME PERFORMANCE; EMISSIONS CLEANER THAN THE ORIGINAL CLEAN AIR ACT STANDARDS, INCLUDING ANY NEW FEDERAL PARTICULATE STANDARDS; THE CAPABILITY TO USE ANY COMBUSTIBLE FLUID AS FUEL (MULTIFUEL CAPABILITY); A SYSTEM SUITABLE FOR PRODUCTION ENGINEERING AND COMMERCIALIZATION. THE GAS TURBINE AND STIRLING ENGINE PROGRAMS REFLECT TWO MAJOR HEAT ENGINE DEVELOPMENT PROGRAMS BEING SPONSORED BY DOE.
DESCRIPTORS AUTOMOBILES: T3;GAS TURBINES: T4;HEAT ENGINES: T2,Q3;RESEARCH PROGRAMS: Q2,Q4,Q5;STIRLING ENGINES: T5;US DOE

G-130

ACCESSION NO. 79J0061623
TITLE MAINTENANCE OF GAS TURBINE ACCESSORY EQUIPMENT
AUTHORS BINGHAM, P.J.; HUHTANEN, P.H.; STARNES, H.G.
AUTHOR AFF GE
PUB DESC POWER ENG., V. 82, NO. 9, PP. 74-77
DATE SEP 1978
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT PROPER DIVISION OF ACCESSORY EQUIPMENT MAINTENANCE INTO TWO TYPES (''RUNNING'' ITEMS AND LARGER SYSTEM UPKEEP ITEMS) AND RECOGNITION OF THE MAJOR CONTRIBUTING COMPONENTS TO OPERATING INCIDENTS, ARE THE FIRST REQUIREMENTS FOR EFFECTIVELY PREPLANNING A MAINTENANCE PROGRAM THAT WILL LEAD TO REDUCED OVERALL MAINTENANCE COSTS AND IMPROVED AVAILABILITY. A RECENT SAMPLING OF 72 REPORTED INCIDENTS RELATED TO LACK OF MAINTENANCE OF ACCESSORY EQUIPMENT, SHOWED FIVE MAJOR CONTRIBUTING COMPONENTS: LUBRICATING OIL PUMPS, MAIN FUEL PUMPS, LOAD COUPLINGS, STARTING DIESEL ENGINE, AND ATOMIZING AIR COMPRESSOR.
DESCRIPTORS ATOMIZATION;AUXILIARY SYSTEMS: Q1;CARBON DIOXIDE;COOLING;DIESEL ENGINES;ELECTRIC BATTERIES;GAS TURBINES: T1;LUBRICATION; MAINTENANCE: Q1;PUMPS

G-131

ACCESSION NO.	79W0049425
TITLE(MONO)	EVALUATION OF ADVANCED REGENERATOR SYSTEMS
EDITOR OR COMP	COOK, J.A.; FUCINARI, C.A.; LINGSCHEIT, J.N.; RAHNKE, C.J.
CORPORATE AUTH	FORD MOTOR CO., DEARBORN, MI (USA)
SEC REPT NO	NASA-CR--159422
PAGE NO	35
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2630
DATE	AUG 1978
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	DOE/NASA/0002--78/4
ABSTRACT	THE MAJOR CONSIDERATIONS WHICH WILL AFFECT THE SELECTION OF A CERAMIC REGENERATIVE HEAT EXCHANGER FOR AN IMPROVED 100 HP AUTOMOTIVE GAS TURBINE ENGINE ARE PRESENTED. THE REGENERATOR CONSIDERED FOR THIS APPLICATION IS ABOUT 36CM (14 IN.) IN DIAMETER. REGENERATOR COMPARISONS ARE MADE ON THE BASIS OF MATERIAL (ALUMINUM SILICATE AND MAGNESIUM ALUMINUM SILICATE), METHOD OF FABRICATION (CORRUGATING, EMBOSSING, AND EXTRUSION), COST, AND PERFORMANCE. A REGENERATOR INLET TEMPERATURE OF 1000$SUP 0$C IS ASSUMED FOR PERFORMANCE COMPARISONS, AND LABORATORY TEST RESULTS ARE DISCUSSED FOR MATERIAL COMPARISONS AT 1100 AND 1200$SUP 0$C. ENGINE TEST RESULTS USING THE FORD 707 INDUSTRIAL GAS TURBINE ENGINE ARE ALSO DISCUSSED.
DESCRIPTORS	ALUMINIUM SILICATES;AUTOMOBILES: T1;CERAMICS;COST: Q3; EXPERIMENTAL DATA: D;FABRICATION: Q3;GAS TURBINES: T2,Q1,D; GRAPHS: D;HEAT EXCHANGERS;MAGNESIUM COMPOUNDS;PERFORMANCE TESTING: Q3;REGENERATORS: T3,Q2,D;THERMODYNAMIC PROPERTIES: D

G-132

ACCESSION NO.	79Y0049164
TITLE	ENGINES AND ENERGY: FUTURE TRENDS
AUTHORS	AGNEW, W.G.
AUTHOR AFF	GENERAL MOTORS RESEARCH LAB., WARREN, MI
TITLE(MONO)	PROCEEDINGS OF A SYMPOSIUM ON IMPLICATIONS OF ENERGY CONSERVATION AND SUPPLY ALTERNATIVES
SEC REPT NO	CONF-760150--
PAGE NO	171-216
CONF TITLE	SYMPOSIUM ON IMPLICATIONS OF ENERGY CONSERVATION AND SUPPLY ALTERNATIVES
CONF PLACE	COLORADO SPRING, CO, USA
CONF DATE	30 JAN 1976
PUBL LOC	SCIENCE APPLICATIONS, INC., EAST BRUNSWICK, NJ
DATE	1976
CATEGORIES	EDB-298000;330100
PRIMARY CAT	EDB-298000
ABSTRACT	DR. AGNEW POINTS OUT THAT IN THE NEAR-TERM (TO ABOUT 1990), NEW ENERGY SOURCES SUCH AS SYNTHETIC FUELS CANNOT MAKE SUBSTANTIAL CONTRIBUTIONS. IN THE LONG TERM (2000 AND BEYOND), WHEN PETROLEUM RESOURCES WILL BE SHORT, WE WILL HAVE TO CONVERT TO SYNTHETIC FUELS DERIVED FROM TAR SANDS, SHALES, OR COAL. THE TRANSPORTATION SECTOR CONSUMES 26% OF ALL U.S. ENERGY AND 55% OF THE PETROLEUM SUPPLY. THE AUTOMOTIVE INDUSTRY IS CONDUCTING POWER-PLANT R AND D PROGRAMS INVOLVING NEAR-TERM MODIFICATIONS TO THE CONVENTIONAL SPARK-IGNITION GASOLINE ENGINE, AS WELL AS RESEARCH ON ALTERNATES TO THE CONVENTIONAL SPARK-IGNITION ENGINE FOR THE LONG-TERM SITUATION. DR. AGNEW SEES IMPROVED CONVENTIONAL ENGINES, LIGHT-DUTY DIESEL ENGINES, AND STRATIFIED-CHARGE ENGINES AS FEASIBLE IN 1978 TO 1985; GAS-TURBINE ENGINES, ELECTRIC BATTERY-POWERED VEHICLES, AND METHANOL-FUELED ENGINES FOR 1985 TO 2000; AND HYDROGEN-FUELED ENGINES AND FUEL CELLS FOR 2000 AND BEYOND. EACH SYSTEM IS BRIEFLY DISCUSSED. A LENGTHY ROUNDTABLE DISCUSSION FOLLOWED. (MCW)
DESCRIPTORS	AUTOMOTIVE FUELS;COMPARATIVE EVALUATIONS;DIESEL ENGINES; ECONOMICS;ELECTRIC-POWERED VEHICLES;ENERGY;ENGINES: T4,Q5; FEASIBILITY STUDIES;FORECASTING: Q4;FUEL CELLS;GAS TURBINES: T2; HYDROGEN;INTERNAL COMBUSTION ENGINES: T1;METHANOL;REVIEWS; STRATIFIED CHARGE ENGINES: T3;SYNTHETIC FUELS;TECHNOLOGY ASSESSMENT: Q1,Q2,Q3;TECHNOLOGY UTILIZATION;VEHICLES: T5

G-133

ACCESSION NO.	79L0048300
TITLE(MONO)	GAS TURBINES FIRED BY SOLID FUELS

EDITOR OR COMP WADE, G.L.
SEC REPT NO CONF-761062--2
PAGE NO 42
AVAILABILITY COMBUSTION POWER CO., INC., 1346 WILLOW RD., MENLO PARK, CA.
CONF TITLE INTERNATIONAL TOTAL ENERGY CONGRESS
CONF PLACE COPENHAGEN, DENMARK
CONF DATE 4 OCT 1976
PUBL LOC COMBUSTION POWER CO., INC., MENLO PARK, CA
DATE 1976
CATEGORIES EDB-200104;200103;200106;014000
PRIMARY CAT EDB-200104
ABSTRACT STEADILY INCREASING ENERGY REQUIREMENTS HAVE SPURRED A SEARCH FOR NEW METHODS OF GENERATING ENERGY FROM LOW-COST, ABUNDANT FUELS. THE DEVELOPMENT OF A GAS-TURBINE SYSTEM EQUIPPED FOR THE DIRECT COMBUSTION OF SUCH FUELS IS NOW UNDERWAY IN THE U.S. A ONE-MEGAWATT PILOT PLANT HAS BEEN OPERATING FOR OVER A YEAR, USING A FLUIDIZED BED TO BURN COAL. THE PLANT HAS ALSO OPERATED ON WOOD WASTE AND MUNICIPAL SOLID WASTE AS FUELS. METHODS HAVE BEEN DEVELOPED FOR THE SUPPRESSION OF NOXIOUS GASES INCLUDED AMONG THE COMBUSTION PRODUCTS, BUT THERE REMAIN SOME PROBLEMS WITH THE REMOVAL OF PARTICULATE MATTER FROM THE EXHAUST GAS PRIOR TO ITS ENTRY INTO THE TURBINE. A NEW HIGH-TEMPERATURE FILTER IS BEING INSTALLED TO ALLEVIATE THESE. A DESCRIPTION OF THE ONE-MEGAWATT PILOT PLANT IS PROVIDED, ALONG WITH A DISCUSSION OF OPERATIONAL RESULTS AND MECHANICAL PROBLEMS AND THEIR SOLUTIONS. A PRELIMINARY DESIGN FOR A FULL-SCALE PLANT IS INCLUDED.
DESCRIPTORS AIR POLLUTION CONTROL;COAL: T2;COMBUSTION PRODUCTS;CONTROL SYSTEMS;DESIGN;EROSION: Q6;FILTERS;FLUIDIZED-BED COMBUSTION: Q2; FLUIDIZED-BED COMBUSTORS: T5,01;FOSSIL-FUEL POWER PLANTS: T1; GAS TURBINES: T6,01;MATERIALS HANDLING;OPERATION;PERFORMANCE: Q5,Q6;PILOT PLANTS;SOLID WASTES;WOOD WASTES

G-134 ACCESSION NO. 79J0048252
TITLE HEAT EXCHANGERS IN GAS TURBINE POWER PLANTS
AUTHORS JAEKEL, G.
PUB DESC ENERGY DEV. (GRAEFELFING), V. 2, NO. 2, PP. 12-20
DATE JUN 1978
CATEGORIES EDB-200104
PRIMARY CAT EDB-200104
ABSTRACT GAS TURBINE POWER PLANTS AS STATIONS FOR PEAK DEMAND CAN BE CONSTRUCTED VERY DIFFERENTLY. FOR ALL THESE PLANTS, HOWEVER, IT IS REQUIRED TO HAVE A SHORT START-UP TIME, A HIGH OPERATIONAL SAFETY AND A LOW OPERATING EXPENDITURE. THOSE SWITCHING POSSIBILITIES AND TECHNIQUES THAT ARE INTERESTING IN THE CASE OF USING THE WASTE GAS HEAT FROM THE GAS TURBINE PROCESS ARE DEMONSTRATED.
DESCRIPTORS GAS TURBINES: T2,01;HEAT EXCHANGERS;HEAT RECOVERY EQUIPMENT; OPERATION: Q2;SAFETY;START-UP: Q2;THERMAL POWER PLANTS: T1; WASTE HEAT;WASTE HEAT UTILIZATION: 01

G-135 ACCESSION NO. 79R0046247
TITLE(MONO) CERAMIC TECHNOLOGY READINESS (CRT) PROGRAM. EXECUTIVE SUMMARY OF INTERIM REPORT ON HICAT CONCEPTUAL DESIGN STUDY
CORPORATE AUTH AIRESEARCH MFG. CO., PHOENIX, AZ (USA)
PAGE NO 25
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT EF-77-C-01-2664
DATE 20 NOV 1976
CATEGORIES EDB-200104;360200
PRIMARY CAT EDB-200104
REPORT NO FE--2664-T1
ABSTRACT THIS REPORT PRESENTS THE RESULTS OF THE CONCEPTUAL DESIGN STUDY ON THE DOE SPONSORED CERAMIC TECHNOLOGY READINESS (CTR) PROGRAM. THE CTR PROGRAM IS INTENDED TO COMPLEMENT THE HIGH TEMPERATURE TURBINE TECHNOLOGY (HTTT) PROGRAM. FOR BOTH PROGRAMS, THE OVERALL OBJECTIVES ARE TO INCREASE THE EFFICIENCY OF UTILITY-SIZE GAS TURBINES BY INCREASING THE TURBINE INLET TEMPERATURE (TO 2600$SUP 0$F AS A GOAL) AND TO OPERATE WITH COAL-DERIVED FUELS. IN THE HTTT PROGRAM, THE TEMPERATURE INCREASE IS OBTAINED THROUGH THE USE OF ADVANCED COOLING TECHNIQUES WITH METALLIC MATERIALS; IN THE CTR PROGRAM, THE

	TURBINES ARE TO BE MADE OF ADVANCED CERAMIC MATERIALS SO THAT THE BLADES AND VANES CAN OPERATE UNCOOLED. LARGE FUEL SAVINGS ARE POSSIBLE IF EITHER OF THESE ADVANCED TECHNOLOGIES CAN BE INTRODUCED INTO COMMERCIAL POWER GENERATION PRACTICE. FOR EXAMPLE, THE BEST INSTALLED FOSSIL STEAM SYSTEMS HAVE A THERMAL EFFICIENCY OF 39 PERCENT WHEN THE SYSTEM IS OPERATED ON AN ENVIRONMENTALLY CLEAN FUEL SUCH AS NATURAL GAS OR LOW SULFUR OIL. IF THIS COULD BE RAISED TO ABOVE 50 PERCENT THROUGH THE USE OF COMBINED GAS TURBINE/STEAM CYCLES OPERATING AT PEAK CYCLE TEMPERATURES OF APPROXIMATELY 2600$SUP 0$F. FUEL USAGE COULD BE REDUCED BY MORE THAN 25 PERCENT. ANNUAL FUEL COST SAVINGS OF HUNDREDS OF MILLIONS OF DOLLARS WOULD RESULT. THUS, THE MAJOR OBJECTIVE FOR THE CTR PROGRAM IS TO DEVELOP CERAMIC FABRICATION AND DESIGN TECHNOLOGY WHICH WILL YIELD LONG LIFE, HOT SECTION COMPONENTS FOR ADVANCED UTILITY GAS TURBINES. THIS REPORT SUMMARIZES THREE HICAT CONCEPTUAL DESIGNS, EACH OF WHICH IS INTEGRATED WITHIN A COMPLETE POWER PLANT CONFIGURATIONTHAT INCLUDES A LURGI COAL GASIFICATION PLANT, THE HICAT GAS TURBINE, AND A STEAM COMBINED CYCLE.
DESCRIPTORS	CERAMICS: T1;COAL LIQUIDS;COMBINED-CYCLE POWER PLANTS: T1; DESIGN: U2;FOSSIL-FUEL POWER PLANTS;GAS TURBINES: T2,Q1;LOW BTU GAS;MATERIALS: Q2;THERMAL EFFICIENCY

G-136

ACCESSION NO.	79C0048246
REPORT NO.PAGE	CONF-781018 PP. VI.40-VI.45
TITLE	HIGH TEMPERATURE CERAMIC HEAT EXCHANGER
AUTHORS	COOMBS, M.G.; KOTCHICK, D.M.
AUTHOR AFF	AIRESEARCH MANUFACTURING CO. OF CALIFORNIA, TORRANCE
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	VI.40-VI.45
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	10 OCT 1978
DATE	1978
CATEGORIES	EDB-200104;360200
PRIMARY CAT	EDB-200104
REPORT NO	CONF-781018--
ABSTRACT	IN MANY ADVANCED SYSTEMS ASSOCIATED WITH THE UTILITY INDUSTRY, THE PERFORMANCE OF THE SYSTEM IS HIGHLY LIMITED BY TEMPERATURES ACHIEVABLE WITH CURRENT METALLIC COMPONENTS. THE USE OF CERAMIC ELEMENTS FOR SOME OF THE CRITICAL COMPONENTS OFTEN CAN PERMIT AN INCREASE OF 1000$SUP 0$F IN OPERATING TEMPERATURE AND RESULT IN IMPROVED PERFORMANCE. TYPICAL APPLICATIONS INCLUDE DIRECT AND INDIRECT FIRED GAS TURBINE ENGINE SYSTEMS, ULTRA-HIGH-TEMPERATURE SOLAR RECEIVERS, COAL GASIFICATION PLANTS, AND HIGH-TEMPERATURE HEAT RECOVERY/COGENERATION INSTALLATIONS. CERAMICS MAY BE BENEFICIAL WHEREVER HIGHER TEMPERATURES PROVIDE EFFICIENCY OR PROCESS ADVANTAGES. THE ELECTRIC POWER RESEARCH INSTITUTE (EPRI) RECOGNIZED THE POTENTIAL OF CERAMIC MATERIALS APPLIED TO ADVANCED UTILITY SYSTEMS AND INITIATED SEVERAL PROGRAMS DIRECTED TO THE DEVELOPMENT OF SUCH SYSTEMS. IN ADDITION TO THE DESIGN STUDY, AN EXTENSIVE EFFORT WAS UNDERTAKEN IN THE AREAS OF CERAMIC MATERIALS CHARACTERIZATION, FABRICATION TECHNIQUES, AND TESTING TO DEVELOP THE TECHNOLOGY BASE FOR SUCH A HEAT EXCHANGER. A SMALL CERAMIC HEAT EXCHANGER MODULE, INCORPORATING MANY OF THE DESIGN FEATURES OF THE FULL-SCALE HEAT EXCHANGER, WAS DEVELOPED, FABRICATED, AND TESTED AT MATERIAL TEMPERATURES UP TO 2300$SUP 0$F. AS A FOLLOW-ON PROGRAM, EPRI REDIRECTED THE EFFORT TO CONCENTRATE ON THE ESTABLISHMENT OF THE DESIGN PHILOSOPHY, MATERIAL DATA BASE, AND FABRICATION TECHNOLOGY REQUIRED FOR SUCCESSFUL UTILIZATION OF CERAMIC HEAT EXCHANGERS. THE OVERALL PROGRAM PLAN FOR THE CURRENT EFFORT IS DESCRIBED.
DESCRIPTORS	CERAMICS: T2;COAL GASIFICATION PLANTS;FABRICATION: Q2;GAS TURBINES;HEAT EXCHANGERS: T1;HEAT RECOVERY;MATERIALS: Q1; MATERIALS TESTING: Q1;SILICON CARBIDES

G-137

ACCESSION NO.	79C0048244
REPORT NO.PAGE	CONF-781018 PP. VI.25-VI.27
TITLE	EVALUATION OF PERFORMANCE OF THERMAL BARRIER COATINGS UNDER GAS TURBINE CONDITIONS

G-137
(cont)

AUTHORS	PALKO, J.E.
AUTHOR AFF	GENERAL ELECTRIC CO., SCHENECTADY, NY
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	VI.25-VI.27
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	10 OCT 1978
DATE	1978
CATEGORIES	EDB-200104;360200
PRIMARY CAT	EDB-200104
REPORT NO	CONF-781018--
ABSTRACT	THE OVERALL OBJECTIVE OF THIS PROGRAM WAS TO ASSESS AND EVALUATE A CONTEMPORARY THERMAL BARRIER COATING (TBC) FOR CORROSION RESISTANCE, PARTICULARLY TO PETROLEUM-FUEL-FIRED GAS TURBINE COMBUSTION PRODUCTS AS MIGHT BE EXPERIENCED IN INDUSTRIAL TURBINE SERVICE. TBC'S IS A RELATIVELY NEW TECHNOLOGY FOR GAS TURBINES WHICH INVOLVES COATING A METAL SUBSTRATE WITH A LOWER THERMAL CONDUCTIVITY, BUT REFRACTORY CERAMIC MATERIAL. THE MAJOR OBJECTIVE IS REDUCTION OF THE GAS STREAM-TO-METAL SUBSTRATE HEAT FLUX. BENEFITS OBTAINED CAN BE LOWER METAL TEMPERATURES, LOWER THERMAL STRESSES IN THE SUBSTRATE, HIGHER OXIDATION/CORROSION RESISTANCE, AND REDUCED REQUIREMENTS FOR COOLANT FLOW OR LESS COMPLEX COOLING CONDITIONS. TBC'S HAS AN IMPRESSIVE HISTORY OF SUCCESSFUL PERFORMANCE IN CLEAN FUEL COMBUSTION ENVIRONMENTS AND OXIDIZING CONDITIONS OF AIRCRAFT ENGINES. TWO MAJOR TASKS WERE ESTABLISHED: PREDICTION OF CORROSIVE CONDENSATES AND CORROSION TESTING (CRUCIBLE TEST, SPRAYED SALT TEST, SMALL BURNER RIG TEST). SPALLATION OF YTTRIA-STABILIZED ZIRCONIA TBC ON NICRALY-COATED IN 738 OCCURRED IN 630 HOURS IN A HOT CORROSION ENVIRONMENT AT 1600$SUP 0$F. SULFIDATION OF THE IN 738 SUBSTRATE MATERIAL TOOK PLACE IN THE HOT CORROSION TESTS WITH THE TBC INTACT DUE TO PERMEATION OF THE POROUS CERAMIC BY NA$SUB 2$SO$SUB 4$. IN SMALL BURNER CORROSION TESTS, THE SPALLING OF Y$SUB 2$O$SUB 3$-STABILIZED ZRO$SUB 2$ THERMAL BARRIER COATINGS IS CAUSED BY MECHANICAL STRESS DAMAGE DUE TO THE DIFFERENCE IN THERMAL EXPANSION OF THE NA$SUB 2$SO$SUB 4$ DEPOSIT IN THE PORES OF THE ZRO$SUB 2$. THE COMPOSITION OF CONDENSATE FROM COAL LIQUIDS AND FROM A PETROLEUM DISTILLATE IS LISTED. DISC SPECIMENS PERFORMED SATISFACTORILY IN OXIDATION TESTING IN THE SMALL BURNER TEST EQUIPMENT.
DESCRIPTORS	COATINGS;CORROSION;GAS TURBINES: T1;MATERIALS: Q1;MATERIALS TESTING: Q2;POROSITY;SODIUM SULFATES;THERMAL SHIELDS: T2,Q1; YTTRIUM OXIDES;ZIRCONIUM OXIDES

G-138

ACCESSION NO.	79C0048243
REPORT NO,PAGE	CONF-781018 PP. VI.1-VI.7
TITLE	TECHNOLOGY FOR CERAMIC TUBE HEAT EXCHANGERS
AUTHORS	WARD, M.E.; METCALFE, A.G.
AUTHOR AFF	SOLAR TURBINES INTERNATIONAL, SAN DIEGO, CA
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	VI.1-VI.7
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	10 OCT 1978
DATE	1978
CATEGORIES	EDB-200104;360200
PRIMARY CAT	EDB-200104
REPORT NO	CONF-781018--
ABSTRACT	PRESENT GAS TURBINES MUST OPERATE WITH HIGH GRADE FUELS TO AVOID DAMAGE WHEN THE COMBUSTION GASES ARE EXPANDED THROUGH THE TURBINE. LOW GRADE FUELS INCLUDING COAL CAN BE USED IF THE TURBINE IS FIRED INDIRECTLY BY TRANSFER OF HEAT FROM THE COMBUSTION GASES TO THE COMPRESSOR AIR BY MEANS OF A HEAT EXCHANGER. THE NEW, SILICON-BASE CERAMICS APPEAR TO BE THE ONLY MATERIALS ABLE TO PROVIDE THE STRENGTH AT TEMPERATURE, EROSION AND CORROSION RESISTANCE, AND THERMAL SHOCK RESISTANCE REQUIRED IN THE TUBES OF THIS HEAT EXCHANGER. THE MATERIALS EVALUATION INCLUDES ENVIRONMENTAL STUDIES ON TUBES AND JOINTS UP TO 2500$SUP 0$F IN TYPICAL COMBUSTION ATMOSPHERES FOR UP TO 1000 HOURS. STRENGTH, STRENGTH DISTRIBUTION AND GAS PERMEABILITY ARE

	ALSO BEING MEASURED. HEAT-UP AND SHUT-DOWN OF A LARGE HEAT EXCHANGER ARE RECOGNIZED TO BE KEY PROBLEMS. ONE SOLUTION IS TO INCORPORATE RELAXING JOINTS IN WHICH A VISCOUS, GLASS-BASE ADHESIVE PERMITS MOVEMENT TO LIMIT PEAK STRESSES. ADAPTATION OF THIS APPROACH FOR HEAT EXCHANGERS WAS STUDIED.
DESCRIPTORS	CERAMICS;GAS TURBINES;HEAT EXCHANGERS: T1;MATERIALS;MATERIALS TESTING: Q1;TUBES;VERY HIGH TEMPERATURE

G-139

ACCESSION NO.	79C0046241
REPORT NO.PAGE	CONF-781018 PP. V.55-V.62
TITLE	MATERIALS AND PROCESS DEVELOPMENT FOR THE WATER-COOLED GAS TURBINE HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM
AUTHORS	SCHILLING, W.F.
AUTHOR AFF	GENERAL ELECTRIC CO., SCHENECTADY, NY
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	V.55-V.62
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	10 OCT 1978
DATE	1978
CATEGORIES	EDB-200104;360103
PRIMARY CAT	EDB-200104
REPORT NO	CONF-781018--
ABSTRACT	A DETAILED STUDY OF CANDIDATE COPPER ALLOYS FOR THE NOZZLE APPLICATION HAS BEEN COMPLETED. MECHANICAL PROPERTY DETERMINATIONS WERE CONDUCTED ON ALLOYS WHICH HAD UNDERGONE THE THERMAL EXPOSURE WHICH IS REQUIRED FOR FABRICATION OF THE PART. THIS CYCLE CONSISTS OF EXPOSURES OF UP TO 950SSUP 0SC FOR 2 HOURS WHICH IS EXTREMELY SEVERE FOR COPPER ALLOYS. TWO COPPER MATERIALS HAVE BEEN CHOSEN: CU--MZC, A COMMERCIAL WROUGHT COPPER ALLOY, AND A POWDER METALLURGY VERSION OF MZC. THE WROUGHT ALLOY WILL BE UTILIZED FOR THE COPPER AIRFOIL SECTION WHILE THE P/M ALLOY WILL BE USED FOR END-WALL FABRICATION. DIFFUSION BONDING STUDIES HAVE IDENTIFIED THE NEED FOR A NICKEL INTERLAYER TO PROVIDE MICROSTRUCTURALLY CLEAN DIFFUSION BONDED JOINTS AT THE COPPER/SPAR, COPPER/TUBE AND COPPER/SKIN INTERFACES. THE COMPOSITE FABRICATION EFFORT IS SUPPORTED BY A SUBSTANTIAL NON-DESTRUCTIVE EVALUATION EFFORT WHOSE GOAL IS TO DEVELOP THE CAPABILITY TO SUCCESSFULLY INTERROGATE THE AS-BONDED COMPOSITE PRIMARILY BY IMMERSION ULTRASONICS. ALLOY 718 HAS BEEN SELECTED AS THE PRIME MATERIAL FOR ALL MONOLITHIC WATER-COOLED COMPONENTS. THIS ALLOY WILL BE USED IN BOTH THE CAST AND FORGED CONDITIONS. HOT ISOSTATIC PRESSING OF THE AS-CAST PARTS HAS BEEN DEMONSTRATED TO PROVIDE BENEFITS IN CASTING HOMOGENIZATION, REDUCED MECHANICAL PROPERTY SCATTER, IMPROVED WELDABILITY AND MACHINABILITY. THE HIGH THERMAL AND MECHANICAL STRESSES IN THESE COMPONENTS COUPLED WITH AN AQUEOUS ENVIRONMENT HAVE CAUSED CONCERN FOR POTENTIAL STRESS-CORROSION CRACKING. A FACILITY FOR SCREENING MATERIALS AT THESE CONDITIONS BY CONSTANT EXTENSION RATE TESTING IN A PRESSURIZED WATER ENVIRONMENT HAS RECENTLY BEEN COMPLETED. TO DATE, NO EVIDENCE OF ENVIRONMENTALLY INDUCED INTERGRANULAR FAILURE HAS BEEN OBSERVED.
DESCRIPTORS	COOLING: Q1;COPPER ALLOYS;FABRICATION;GAS TURBINES: T1;HOT PRESSING;MATERIALS;MATERIALS TESTING: Q1;MECHANICAL PROPERTIES; STRESS CORROSION;WATER

G-140

ACCESSION NO.	79C0048240
REPORT NO.PAGE	CONF-781018 PP. V.53-V.54
TITLE	LONG LIFE MATERIALS: CORROSION EVALUATION, CRITICAL RESEARCH AND ADVANCED TECHNOLOGY SUPPORT PROJECT (CRT)
AUTHORS	LOWELL, C.E.
AUTHOR AFF	NATIONAL AERONAUTIC AND SPACE ADMINISTRATION, CLEVELAND, OH
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	V.53-V.54
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	10 OCT 1978
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CATEGORIES	EDB-200104

PRIMARY CAT	EDB-200104
REPORT NO	CONF-781018--
ABSTRACT	THE PRIMARY OBJECTIVES OF THIS PROGRAM ARE: TO EVALUATE THE EFFECT OF COAL DERIVED FUEL COMBUSTION ON THE CORROSION OF TURBINE AND ALLOY COATINGS AND TO DEVELOP A LIFE PREDICTION MODEL FOR MATERIALS EXPOSED TO COMBUSTION PRODUCTS OF COAL-DERIVED FUELS AND CORRELATE THIS MODEL WITH A CORROSION DATA BASE. THE PROGRAM IS DIVIDED INTO THREE MAJOR AREAS: THE FUEL CORROSIVITY PREDICTION TASK USES STATISTICALLY-DESIGNED, MULTIVARIABLE, DOPED-FUEL BURNER RIG TESTS TO DETERMINE THE EFFECT OF TEMPERATURE, NA, K, MG, CA, AND CL, AND THEIR INTERACTIONS ON THE CORROSION OF SEVERAL CAST SUPERALLOYS. THE DEPOSITION AND FOULING TASK INVOLVES USING A CHEMICAL EQUILIBRIUM COMPUTER PROGRAM TO PREDICT THE COMPOSITIONS AND DEW POINTS OF DEPOSITS FORMED FROM THE COMBUSTION OF COAL-DERIVED FUEL. THE THERMAL BARRIER COATING TASK IS DESIGNED TO EVALUATE THE RESISTANCE OF CURRENT AND ADVANCED THERMAL BARRIER COATINGS TO THE COMBUSTION PRODUCTS OF COAL-DERIVED FUELS. THIS TASK IS ALSO DESIGNED TO DETERMINE THE FAILURE MECHANISMS OF SUCH COATING SYSTEMS.
DESCRIPTORS	COAL LIQUIDS;COATINGS;COMBUSTION PRODUCTS;COOLING;CORROSION; CORROSION RESISTANCE;CORROSIVE EFFECTS;DEPOSITS;FORECASTING; FOULING;FUEL GAS;GAS TURBINES: T1;HEAT TRANSFER;MATERIALS: 01; SERVICE LIFE

G-141

ACCESSION NO.	79C0046239
REPORT NO.PAGE	CONF-781018 PP. V.47-V.52
TITLE	HIGH TEMPERATURE TURBINE TECHNOLOGY
AUTHORS	MOGUL, J.
AUTHOR AFF	CURTISS--WRIGHT CORP., WOOD-RIDGE, NJ
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	V.47-V.52
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	10 OCT 1978
DATE	1978
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
REPORT NO	CONF-781018--
ABSTRACT	THE OBJECTIVE OF THIS PROGRAM IS TO DEVELOP, TO A TECHNOLOGY READINESS LEVEL, THE TURBINE SUB-SECTION OF GAS TURBINE, CAPABLE OF OPERATION: ON LOW BTU COAL-GAS FUEL AND AT TURBINE INLET TEMPERATURES OF 2600 TO 3000$SUP 0$F. COMBUSTED, COAL-DERIVED LOW BTU FUEL GAS ENTERING THE TURBINE SECTION, IN ADDITION TO ITS VERY HIGH TEMPERATURES, MAY CONTAIN PARTICLES OF FLY ASH, CHAR, TARS, DUST AND OTHER CONSTITUENTS, SUCH AS ALKALI METAL SALTS, WHICH CAN CAUSE RAPID DEGRADATION IN BLADE AND VANE PERFORMANCE AND DURABILITY. DEGRADATION OF THE TURBINE CAN OCCUR BY FOUR MAJOR MECHANISMS: GAS TEMPERATURES ABOVE THE MELTING POINT OF THE ALLOYS, HOT CORROSION, EROSION, AND DEPOSITION. TO OVERCOME THESE PROBLEMS COOLING/PROTECTION CONCEPTS FOR TURBINE BLADES AND VANES SHOULD BE ABLE TO ACCOMPLISH THE FOLLOWING: KEEP METAL TEMPERATURES IN A RANGE THAT WILL ENSURE ADEQUATE LONG TIME STRUCTURAL STABILITY, PROVIDE A BOUNDARY LAYER BETWEEN THE METAL SURFACE AND THE HOT-GASES TO PREVENT DEPOSITION OR IMPINGEMENT OF PARTICULATE AND CONDENSIBLES, AND ALLOW FOR FABRICATION FROM STATE-OF-THE-ART MATERIALS AND PROCESSES. AMONG THE MAJOR ACCOMPLISHMENTS: CONCEPTUAL DESIGNS OF AN INTEGRATED LOW BTU COAL GAS FUELED COMMERCIAL ELECTRIC POWER GENERATION PLANT; PRELIMINARY DESIGNS OF A GAS TURBINE-STEAM TURBINE COMBINED CYCLE SYSTEM; AND PRELIMINARY DESIGNS OF A 3000$SUP 0$F TURBINE SUB-SYSTEM USING TRANSPIRATION-AIR-COOLING AS THE COOLING/PROTECTION CONCEPT FOR BLADES AND VANES. TRANSPIRATION-AIR-COOLING WAS SELECTED AS THE CONCEPT WHICH OFFERED 3000$SUP 0$F TURBINE INLET TEMPERATURE CAPABILITY COMBINED WITH THE HEAT COMBINATION OF CYCLE PERFORMANCE, RELIABILITY, FABRICABILITY FROM STATE-OF-THE-ART MATERIALS AND PROCESSES, AND POTENTIAL FOR EARLY COMMERCIALIZATION. THE KEY ELEMENT IN THE DESIGN IS THE POROUS METAL WHICH FORMS THE AIRFOIL. SINTERED WIRE MESH PROVIDES THE OPTIMUM COMBINATION OF POROSITY CONTROL, FABRICABILITY INTO AIRFOIL SHAPES, AND

	ADEQUATE PROPERTIES.
DESCRIPTORS	COMBINED-CYCLE POWER PLANTS: T1;COOLING;DESIGN: Q3;FABRICATION; FUEL GAS;GAS TURBINES: T2,Q1;LOW BTU GAS;MATERIALS: Q3;TURBINE BLADES: T3,Q2;VERY HIGH TEMPERATURE

G-142

ACCESSION NO.	79C0046238
REPORT NO.PAGE	CONF-761018 PP. V.44-V.46
TITLE	HOT CORROSIVITY OF COAL GASIFICATION PRODUCTS ON GAS TURBINE ALLOYS
AUTHORS	MEIER, G.H.; STOEHR, R.A.
AUTHOR AFF	UNIV. OF PITTSBURGH, PA
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	V.44-V.46
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	10 OCT 1976
DATE	1976
CATEGORIES	EDB-200104;360105;010404;010600
PRIMARY CAT	EDB-200104
AUGMENTATION	THERMOCHEMICAL AND ELECTROCHEMICAL DATA
REPORT NO	CONF-761018--
ABSTRACT	THIS STUDY IS INTENDED TO SERVE THE DUAL PURPOSE OF DEVELOPING A FUNDAMENTAL UNDERSTANDING OF HOT CORROSION PROCESSES AND OF PROVIDING DATA ESSENTIAL IN THE DESIGN AND SELECTION OF ALLOYS FOR USE IN TURBINES USING GASIFIED COAL AS FUEL. THE AVAILABLE THERMOCHEMICAL DATA FOR SPECIES IN THE METAL--SULFUR OXYGEN AND METAL--CARBON OXYGEN SYSTEMS OF INTEREST IN THE STUDY HAVE BEEN REVIEWED; AND LOG P/SUB S$SUB 2$/ VS LOG P/SUB O$SUB 2$/ CONDENSED PHASE STABILITY DIAGRAMS HAVE BEEN CONSTRUCTED FOR THE TEMPERATURE INTERVAL 1150 TO 1450$SUP 0$K FOR THE METALS AL, CA, CO, CR, K, MG, MO, NA, NI, SI, TI, V AND W AND LOG A/SUB C/ VS LOG P/SUB O$SUB 2$/ DIAGRAMS FOR THE METALS AL, CA, CR, FE, MG, MN, MO, NA, SI, TI, V, AND W. THE THERMOCHEMICAL DATA FOR THE VAPOR SPECIES IN SELECTED METAL--OXYGEN AND METAL--SULFUR SYSTEMS HAVE BEEN CARRIED OUT; AND VAPOR SPECIES DIAGRAMS (LOG P//SUB MO//SUB X// VS LOG P/SUB O$SUB 2$/ AND LOG P//SUB MS//SUB Y// VS LOG P/SUB S$SUB 2$/) HAVE BEEN PREPARED FOR THE METALLIC ELEMENTS MENTIONED PREVIOUSLY. ELECTROCHEMICAL CELL MEASUREMENTS OF THE OXIDE ION CONCENTRATION IN NA$SUB 2$SO$SUB 4$ HAVE BEEN MADE FOR VARIOUS ADDITIVES SUCH AS K$SUB 2$SO$SUB 4$, SIO$SUB 2$, TIO$SUB 2$, C, AND MGO. HOT CORROSION HAS BEEN STUDIED IN THE TEMPERATURE RANGE 1150 TO 1350$SUP 0$K FOR PURE NI AND CO, LABORATORY NI- AND CO-BASE ALLOYS AND SEVERAL COMMERCIAL ALLOYS WHEN DEPOSITS OF K$SUB 2$SO$SUB 4$, CASO$SUB 4$, OR NA$SUB 2$SO$SUB 4$ MODIFIED WITH SEVERAL ADDITIVES WERE PRESENT. THE RESULTS THUS FAR HAVE INDICATED THAT ALLOY COMPOSITIONS CONSISTENT WITH HIGH STRENGTH (E.G., THOSE CONTAINING TI FOR PRECIPITATION HARDENING AND REFRACTORY METALS FOR SOLID SOLUTION STRENGTHENING) MAY NOT BE COMPATIBLE WITH THE RANGE OF HOT CORROSION CONDITIONS LIKELY TO BE FOUND IN TURBINES BURNING GASIFIED COAL. THE USE OF COATINGS FOR HOT CORROSION RESISTANCE MAY BE ESSENTIAL.
DESCRIPTORS	COAL GASIFICATION;CORROSION;CORROSIVE EFFECTS: Q1,Q2;DEPOSITS; FLUE GAS: M2;FLUIDIZED BED;FUEL GAS: M1;GAS TURBINES: M3;LOW BTU GAS;MATERIALS: Q3;MATERIALS TESTING: Q3;PHASE STABILITY; PHASE STUDIES;PROTECTIVE COATINGS;SODIUM SULFATES;SULFATES

G-143

ACCESSION NO.	79C0048234
REPORT NO.PAGE	CONF-761018 PP. K.185-K.230
TITLE	MATERIALS FOR TURBINE APPLICATIONS WITH COAL DERIVED FUELS
AUTHORS	DAPKUNAS, S.J.
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	K.185-K.230
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
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CATEGORIES	EDB-200104;360105;010600;014000
PRIMARY CAT	EDB-200104
REPORT NO	CONF-761018--

ABSTRACT — RELATIVELY SHORT TESTS, WHEREIN COAL-DERIVED GAS AND LIQUID FUELS HAVE BEEN COMBUSTED, SUGGEST THAT EROSION OR FOULING WILL NOT BE A PROBLEM WITH FUELS OF REASONABLY ACHIEVABLE ASH LEVELS. HOWEVER, HOT CORROSION ATTACK BY ALKALIS IN THE FUEL MAY WELL BE SEEN EVEN WITH EXTENSIVE FUEL CLEANING. THE NEED FOR MATERIALS WITH GOOD HOT CORROSION RESISTANCE IS APPARENT. THE DEVELOPMENT OF HIGH TEMPERATURE TURBINE COMPONENTS TO OPERATE IN THE COMBUSTION PRODUCTS OF COAL-DERIVED FUELS MAY WELL INCUR SERIOUS DRAWBACKS FROM FOULING AND CONSEQUENT COOLING SYSTEMS PLUGGING WHILE CONCURRENTLY AVOIDING HOT CORROSION BY MEANS OF REDUCED METAL TEMPERATURES. THE USE OF POWER RECOVERY TURBINES PRESENTS SEVERE PROBLEMS BOTH FROM THE STANDPOINT OF EROSION AND CORROSION ATTACK. PAST EXPERIENCE SUGGESTS THAT FOULING MAY BE A PROBLEM IN THESE APPLICATIONS. SEVERAL SIGNIFICANT RESEARCH NEEDS ARE APPARENT FOR TURBINE MATERIALS. THE NATURE OF THE ATMOSPHERE AND DEPOSITS TO BE EXPECTED BY THE COMBUSTION OF SYNTHETIC FUELS AND COAL DIRECTLY IN A PFB REQUIRES IDENTIFICATION, PARTICULARLY AS A FUNCTION OF PROCESS PARAMETERS. BECAUSE OF COST, EFFICIENCY CONSIDERATIONS AND RELIABILITY OF HOT GAS PARTICULATE CLEAN-UP SYSTEMS, THE TOLERANCE OF TURBINE COMPONENTS TO EROSIVE CONDITIONS, WITH SPECIAL REGARD TO TOLERANCE FOR UPSET CONDITIONS NEEDS TO BE DETERMINED. THIS SHOULD ENCOMPASS THE DEVELOPMENT OF COATINGS AND CLADDINGS FOR EROSION AS WELL AS CORROSION RESISTANCE.

DESCRIPTORS — ALKALI METAL COMPOUNDS;ASHES;COAL LIQUIDS: T2;COMBUSTION PRODUCTS: Q5;CORROSION: Q1;ELEMENTS;ENERGY RECOVERY;EROSION: Q1; FLUIDIZED-BED COMBUSTORS: T5;FUEL GAS: T3;GAS TURBINES: T1;HOT GAS CLEANUP;LOW BTU GAS;MATERIALS: Q1;PARTICLE SIZE;PARTICLES; REMOVAL;SERVICE LIFE: Q1;SPECIFICATIONS: Q2,Q3;SULFATES;TRACE AMOUNTS

G-144

ACCESSION NO.	79C0047037
REPORT NO.PAGE	CONF-781018 PP. V.4-V.8
TITLE	FIRESIDE CORROSION TASK II: INVESTIGATION OF GAS TURBINE MATERIALS FOR USE IN THE EXHAUST GAS FROM A PRESSURIZED FLUIDIZED-BED COAL COMBUSTOR
AUTHORS	MCCARRON, R.L.
AUTHOR AFF	GENERAL ELECTRIC CO., SCHENECTADY, NY
TITLE(MONO)	THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO	V.4-V.8
CONF TITLE	3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
CONF PLACE	GAITHERSBURG, MD, USA
CONF DATE	10 OCT 1978
DATE	1978
CATEGORIES	EDB-014000;421000;200104;360105
PRIMARY CAT	EDB-014000
REPORT NO	CONF-781018--

ABSTRACT — SIMULATION OF THE PRESSURIZED FLUIDIZED-BED CONDITIONS IN THE ONE ATMOSPHERE SMALL BURNER RIG HAS EVOLVED TO A SIGNIFICANT EXTENT UNDER THIS PROGRAM. A COMBINATION OF CORROSION TESTING, SPECIMEN AND DEPOSIT ANALYSIS, AND THERMOCHEMICAL MODELING HAS BEEN USED TO DEVELOP A MEANINGFUL SIMULATION TEST. OVER 4000 HOURS OF SMALL BURNER RIG TESTING HAS ACCUMULATED IN EVALUATING THE SELECTED MATERIALS AND DEVELOPING THE PFBC SIMULATION TESTS. THE ALKALI METAL CONTAMINANTS ARE ADDED TO THE FUEL VIA OIL SOLUBLE NA SULFONATE AND A DISPERSED AQUEOUS SOLUTION OF K SULFONATE. TARGET LEVELS ARE 1000 PPM EACH OF NA AND K IN THE FUEL. CHLORINE IS ADDED TO THE INLET AIR AS 40 PPM HCL. THE RESULT OF COMBUSTION WITH THESE CONTAMINANTS PRESENT IS AN ALKALI SULFATE DEPOSIT WITH 0.01 TO 0.1% CHLORIDE ON THE ALLOY SPECIMENS. ANALYSES HAVE SHOWN THAT THE COMPOSITION OF THE DEPOSIT AND THE FLUX OF DEPOSIT ONTO THE SPECIMENS APPROXIMATE THAT EXPECTED IN A TURBINE IN LINE WITH A PFBC. CORROSION ON SPECIMENS IN THIS TEST WILL BE COMPARED TO THAT OCCURRING ON THE SAME MATERIALS EXPOSED IN AN ACTUAL PFBC. SPECIMENS OF THE SAME FOUR MATERIALS BEING TESTED IN THE SMALL BURNER TEST ARE BEING EVALUATED IN THE TURBINE TEST SECTION WHICH WAS DESIGNED AND FABRICATED BY G.E. AND INSTALLED AT THE EXXON MINIPLANT. A 100 HOUR SHAKEDOWN TEST AND 250 HOURS OF THE 1000 HOUR TEST HAVE BEEN COMPLETED. THE TURBINE TEST SECTION OPERATED SUCCESSFULLY AT ITS RATED DESIGN CONDITIONS. SPECIMENS OF U700 ALLOY FROM THE 100 HOUR SHAKEDOWN TEST WERE EXAMINED IN DETAIL

AND THESE SHOWED SULFIDATION, EROSION AND DEPOSITION PROCESSES OCCURRING SIMULTANEOUSLY NEAR THE SPECIMEN LEADING EDGE.

DESCRIPTORS — ALKALI METAL COMPOUNDS;CHLORIDES;CORROSION;DEPOSITS;EROSION; FLUE GAS;FLUIDIZED-BED COMBUSTORS: T1;GAS TURBINES: T2; MATERIALS;MATERIALS TESTING: Q1,Q2;POTASSIUM;SIMULATION;SODIUM; SULFATES

G-145

ACCESSION NO. — 79C0047036
REPORT NO.PAGE — CONF-761016 PP. V.1-V.3
TITLE — HOT CORROSION EROSION TESTING OF MATERIALS FOR APPLICATION TO ADVANCED POWER CONVERSON SYSTEMS USING COAL-DERIVED FUELS
AUTHORS — NUTKIS, M.S.
AUTHOR AFF — EXXON RESEARCH AND ENGINEERING CO., LINDEN, NJ
TITLE(MONO) — THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO — V.1-V.3
CONF TITLE — 3. CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
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CONF DATE — 10 OCT 1976
DATE — 1978
CATEGORIES — EDB-014000;421000;360105
PRIMARY CAT — EDB-014000
REPORT NO — CONF-761016--
ABSTRACT — MODIFICATIONS TO THE EXXON PRESSURIZED FLUIDIZED-BED COAL COMBUSTION MINIPLANT ARE COMPLETE WITH PORTS AVAILABLE FOR 12 IN-BED AND 10 ABOVE-BED HEAT EXCHANGER SPECIMEN PROBE ASSEMBLIES. THE INSTALLED TEMPERATURE CONTROL SYSTEM FOR THE SPECIMEN PROBES PROVIDES INDEPENDENT TEMPERATURE CONTROL OF EACH PROBE BY REGULATING THE AMOUNT OF COOLING AIR DELIVERED. THIS PROVIDES A RELIABLE, INDEPENDENT AND READILY ADJUSTABLE TEMPERATURE CONTROL SYSTEM FOR THE 21 SPECIMEN PROBES (SUPPLIED BY WESTINGHOUSE RESEARCH). IT PERMITS CONTROL OF THE 12 IN-BED SPECIMEN PROBES AT MEAN TEMPERATURES OF 1050$SUP 0$F, 1200$SUP 0$F, 1400$SUP 0$F AND 1600$SUP 0$F, AND THE 9 ABOVE-BED MATERIAL PROBES AT TEMPERATURES OF 1200$SUP 0$F, 1400$SUP 0$F, AND 1600$SUP 0$F. EACH PROBE IS COMPOSED OF 2 ALLOY SPECIMENS AND THREE SPECIMEN PROBES WILL BE TESTED AT EACH TEMPERATURE. A DATA LOGGER SYSTEM IS INSTALLED FOR INDIVIDUAL PROBE TEMPERATURE MONITORING AND ALARM. THE TURBINE TEST SECTION (SUPPLIED BY GENERAL ELECTRIC) WILL PROVIDE A REGION WITH REPRESENTATIVE FLOW VELOCITIES FOR FURNISHING ENGINEERING INFORMATION ON THE CORROSION/EROSION DETERIORATION OF GAS TURBINE MATERIALS EXPOSED TO THE EXHAUST GAS FROM A PRESSURIZED FLUIDIZED-BED COAL COMBUSTOR. THE SHAKEDOWN PHASE OF THIS PROGRAM HAS BEEN COMPLETED. HEAT EXCHANGER SPECIMEN PROBES AND TURBINE BLADE MATERIALS WERE EXPOSED TO PRESSURIZED FLUIDIZED-BED COAL COMBUSTION CONDITIONS FOR TESTS OF 17 HOURS AND 100 HOURS. TEMPERATURE CONTROL OF THE 21 HEAT EXCHANGER PROBES WAS EXCELLENT, AND THE PROBE SPECIMENS SHOWED NO VISIBLE SIGNS OF ATTACK AFTER 117 HOURS OF EXPOSURE. THE AIRFOIL-SHAPED TURBINE SPECIMENS (U-700) EXPERIENCED A REGULAR PATTERN OF FLY ASH DEPOSITION, SOME SIGNS OF EROSION AT THE LEADING EDGE AND ON 1 OR 2 SPECIMENS SIGNS OF VERY LOCALIZED INCIPIENT CORROSION NEAR THE LEADING EDGE.
DESCRIPTORS — COAL: T1;CORROSION;EROSION;FLUIDIZED-BED COMBUSTION: Q1; FLUIDIZED-BED COMBUSTORS: T2;GAS TURBINES: T4;HEAT EXCHANGERS: T3;MATERIALS: Q2,Q3,Q4;MATERIALS TESTING: Q2,Q3,Q4;TEST FACILITIES;VERY HIGH TEMPERATURE

G-146

ACCESSION NO. — 79C0046756
REPORT NO.PAGE — CONF-761018 PP. V.34-V.39
TITLE — DESIGN OF MATERIALS FOR USE UNDER EROSION-HOT CORROSION CONDITIONS IN COAL GASIFICATION AND COAL COMBUSTION SYSTEMS
AUTHORS — BARKALOW, R.H.; GOEBEL, J.A.; PETTIT, F.S.
AUTHOR AFF — PRATT AND WHITNEY AIRCRAFT, MIDDLETOWN, CT
TITLE(MONO) — THIRD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION
PAGE NO — V.34-V.39
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CONF PLACE — GAITHERSBURG, MD, USA
CONF DATE — 10 OCT 1976
DATE — 1976

CATEGORIES EDB-010404;200104;360105
PRIMARY CAT EDB-010404
REPORT NO CONF-781016--
ABSTRACT CONCLUSIONS FROM PREVIOUS OXIDATION-EROSION WORK ARE SUMMARIZED WITH RESPECT TO: PARTICLE SIZE, PARTICLE HARDNESS, PARTICLE CONCENTRATION, IMPACT ANGLE, IMPACT VELOCITY AND CERTAIN MATERIAL PROPERTIES SUCH AS OXIDATION RESISTANCE AND HARDNESS. A BASELINE HOT CORROSION TEST WAS RUN BY INJECTING AN AQUEOUS SOLUTION OF NA$SUB 2$SO$SUB 4$--25 MOL% K$SUB 2$SO$SUB 4$ INTO THE PRIMARY COMBUSTOR. WEIGHT LOSSES OF THE TEST MATERIALS ARE PLOTTED. AN EROSION-HOT CORROSION EXPERIMENT WAS RUN UNDER IDENTICAL CONDITIONS EXCEPT FOR THE ADDITION OF 300 PPM OF 2MUM AL$SUB 2$O$SUB 3$ PARTICLES TO THE GAS STREAM. WEIGHT LOSSES ARE MUCH LARGER THAN THOSE ATTRIBUTABLE TO THE SUM OF EROSION AND HOT CORROSION PROCESSES ACTING ALONE. AGAIN SILICON NITRIDE WAS FOUND TO BE HIGHLY RESISTANT TO CONDITIONS WHICH CAUSED RAPID ATTACK OF METALLIC ALLOYS. THE NATURL AND SEVERITY OF EROSION-HOT CORROSION ATTACK IS ILLUSTRATED BY A SERIES OF PHOTOMICROGRAPHS OF COCRALY-COATED IN 738. IN TESTING WITH OTHER TYPES OF SOLID PARTICLES, IT WAS FOUND THAT THE RATE OF MATERIAL CONSUMPTION WAS NOT AFFECTED BY PARTICLE HARDNESS (THE MGO POWDER WHICH CAUSED RELATIVELY MILD EROSION UNDER OXIDIZING CONDITIONS WAS AS DAMAGING AS AL$SUB 2$O$SUB 3$ IN EROSION-HOT CORROSION), AND THAT DEPOSITION OF FINE, INERT PARTICLES (0.3MUM AL$SUB 2$O$SUB 3$) REDUCED THE SEVERITY OF HOT CORROSION. THESE RESULTS, AS WELL AS THOSE OF THE ORIGINAL EXPERIMENT WITH 2MUM AL$SUB 2$O$SUB 3$, CAN BE RATIONALIZED BY AN EROSION-HOT CORROSION MODEL BASED ON DAMAGE TO THE CORROSIVE SCALE BY THE IMPACTING PARTICLES, RENDERING IT LESS PROTECTIVE AND PROMOTING THE INGRESS OF SULFUR INTO THE ALLOY.
DESCRIPTORS COAL GASIFICATION PLANTS: T1;COATINGS;CORROSION;EROSION; FOSSIL-FUEL POWER PLANTS: T2;GAS TURBINES: T3;HAYNES 188 ALLOY; MATERIALS;MATERIALS TESTING: Q1,Q2,Q3;MATHEMATICAL MODELS; POTASSIUM SULFATES;SILICON NITRIDES;SODIUM SULFATES

G-147

ACCESSION NO. 79C0046728
TITLE(MONO) STATE OF COAL GASIFICATION
EDITOR OR COMP VAN HEEK, K.H.
CORPORATE AUTH BERGBAU-FORSCHUNG G.M.B.H., ESSEN (GERMANY, F.R.)
SEC REPT NO CONF-771261--9
PAGE NO 39
AVAILABILITY DEP. NTIS (US SALES ONLY), PC A03/MF A01.
CONF TITLE CONFERENCE ON COAL GASIFICATION AND HYDROGENATION
CONF PLACE ESSEN, F.R. GERMANY
CONF DATE 7 DEC 1977
DATE 1977
LANGUAGE IN GERMAN
CATEGORIES EDB-010404;210900
PRIMARY CAT EDB-010404
REPORT NO AED-CONF--77-565-005
ABSTRACT THE PHYSICAL-CHEMICAL AND ENGINEERING FUNDAMENTALS OF COAL GASIFICATION ARE DESCRIBED; THE INDUSTRIAL METHODS OF GAS PRODUCTION AVAILABLE TODAY AND THE NEW DEVELOPMENTS ARE EXPLAINED. NUMEROUS METHODS HAVE BEEN SUGGESTED AND BEEN PUT INTO USE FOR THE TECHNICAL PERFORMANCE. TODAY THERE ARE ONLY PRACTICALLY 3 METHODS AVAILABLE FOR INDUSTRIAL USE IN WHICH THE GASIFICATION IS CARRIED OUT AUTOTHERMALLY WITH A STEAM--OXYGEN MIXTURE IN A FIXED BED (LURGI), IN A FLUIDIZED BED (WINKLER) AND IN A FUEL-DUST CLOUD (KOPPERS/TOTZEK). MOST OF THE GERMAN GASIFICATION PROJECTS AIM AT A FURTHER DEVELOPMENT OF THE CONVENTIONAL TECHNIQUES FOR OPERATION AT HIGHER PRESSURES, AT IMPROVING THE EFFICIENCY AND AT EXPANDING THE COAL BASIS. COAL GASIFICATION WITH NUCLEAR HEAT AIMS TO REPLACE COAL AS THE ENERGY SOURCE BY NUCLEAR PROCESS HEAT AND THUS TO MAKE BETTER USE OF COAL, TO AVOID COAL-SPECIFIC EMISSIONS AND TO IMPROVE THE EFFICIENCY AS WELL AS THE PROFITABLENESS OF GASIFICATION PROCESSES. THE MAIN IMPORTANCE IN THE PROJECTS DONE IN THE USA IS THE PRODUCTION OF METHANE BY COMBINATION OF AUTOTHERMAL AND ALLOTHERMAL STEAM GASIFICATION WITH METHANATION OR/AND WITH HYDROGASIFICATION. FINALLY, GASIFICATION PROCESSES ARE DEVELOPED FOR ENVIRONMENTALLY SAFE ELECTRICITY GENERATION IN COMBINATION WITH THE GAS TURBINE PROCESS. THE NEW DEVELOPMENTS SHOULD BE TECHNICALLY READY FOR INDUSTRIAL USE AFTER 1985 WHEREBY NUCLEAR COAL GASIFICATION WILL NOT BE APPLIED ON A LARGE SCALE UNTIL THE NINETIES.
DESCRIPTORS BI-GAS PROCESS;CHEMICAL REACTION KINETICS: Q1;COAL GASIFICATION: T1;EFFICIENCY;EMISSION;GAS TURBINES;GERMAN FEDERAL REPUBLIC;HYDROGENATION;HYGAS PROCESS;KOPPERS-TOTZEK PROCESS: T4;LURGI PROCESS: T2;METHANATION;METHANE;OPTIMIZATION: Q2,Q3,Q4;POWER GENERATION;PRESSURE DEPENDENCE;PROCESS HEAT REACTORS;REVIEWS;THERMODYNAMICS: Q1;WINKLER PROCESS: T3

G-148

ACCESSION NO. 79R0041610
TITLE(MONO) FAULT TREE ANALYSIS FOR RELIABILITY PREDICTION OF GAS TURBINE TYPE POWER PLANTS. VOLUME 2. APPENDIXES. FINAL REPORT

EDITOR OR COMP KELLY, J.E.; ERDMANN, R.C.; GILBERT, K.
CORPORATE AUTH SCIENCE APPLICATIONS, INC., PALO ALTO, CA (USA)
PAGE NO 65
AVAILABILITY DEP. NTIS, PC A05/MF A01.
DATE JUN 1976
CATEGORIES EDB-200100
PRIMARY CAT EDB-200100
REPORT NO EPRI-AF--611(VOL.2APP.)
ABSTRACT FAULT TREE ANALYSIS IS A PROCEDURE USED TO EXAMINE SYSTEMS TO DETERMINE COMPONENT FAILURE MODES AND OTHER EVENTS (E.G., OPERATOR ERRORS) WHICH CAN, INDIVIDUALLY OR IN COMBINATION, CAUSE A SYSTEM FAILURE RESULTING IN DOWNTIME. A SYSTEM FAULT TREE IS A LOGIC DIAGRAM WHICH DEPICTS THE COMPONENT FAILURE MODES AND OTHER FAULT EVENTS CAPABLE OF PRODUCING, THROUGH AND AND OR COMBINATORIAL LOGIC, SYSTEM FAILURE. IT IS A BINARY MODEL OF THE FAULT MODES OF A SYSTEM AND, AS SUCH, CAN BE READILY CONVERTED TO A PROBABILISTIC MODEL OF THE SYSTEM. INDIVIDUAL COMPONENT FAULT PROBABILITIES CAN BE ASSIGNED TO THE MODEL AND COMBINED TO OBTAIN SYSTEM FAILURE PROBABILITIES. THE SYMBOLISM USED IN THE FAULT TREE ANALYSIS IN THIS STUDY IS SHOWN AND DEFINED. THE GAS TURBINE AT THE NAVAL STATION PLANT STUDIED IS DEPICTED. ALL THE SUBSEQUENT FIGURES SHOW THE TREE TOP AND ITS 36 BRANCHES THAT WERE CONSTRUCTED IN THIS STUDY.
DESCRIPTORS DIAGRAMS;FAULT TREE ANALYSIS: Q1,Q2;FORECASTING;FOSSIL-FUEL POWER PLANTS: T2;GAS TURBINES: T1;RELIABILITY: Q1,Q2

G-149

ACCESSION NO. 79J0037536
TITLE MATERIALS PROBLEMS IN COAL GASIFICATION AND LIQUEFACTION
AUTHORS LOCHMANN, W.J.
AUTHOR AFF RALPH M. PARSONS CO., PASADENA, CA
PUB DESC METALL. TRANS., A, V. 9, NO. 2, PP. 175-181
DATE FEB 1978
CATEGORIES EDB-360105;360205;010404;010405
PRIMARY CAT EDB-360105
ABSTRACT THE CONVERSION OF COAL TO ''CLEAN'' FUELS IMPOSES SEVERE DEMANDS ON MATERIALS OF CONSTRUCTION. THE OPERATIONAL ENVIRONMENTS EXPERIENCED BY THESE MATERIALS MAY BE HIGH TEMPERATURES AND HIGH PRESSURES AND CONTAIN SUBSTANTIAL QUANTITIES OF H$SUB 2$S, H$SUB 2$, ORGANIC ACIDS, CHLORIDES AND PARTICULATE MATTER. EXPERIENCES TO DATE INDICATE THAT CORROSION AND EROSION PROBLEMS WILL TAX MATERIALS ENGINEERS AND DESIGNERS. THIS PAPER DISCUSSES MATERIAL PROBLEM AREAS AND REQUIREMENTS THAT HAVE BEEN IDENTIFIED FOR COAL CONVERSION PLANTS. A SUMMARY OF CRITICAL MATERIAL SELECTION AREAS FOR COAL GASIFICATION AND LIQUEFACTION PLANTS IS GIVEN.
DESCRIPTORS ALUMINIUM OXIDES: T6;CARBON STEELS: T5;CHROMIUM STEELS: T3; CHROMIUM-MOLYBDENUM STEELS: T4;COAL GASIFICATION: T1;COAL LIQUEFACTION: T2;CORROSION: Q3,Q4,Q5,Q6,Q7;CORROSION PROTECTION; EROSION: Q3,Q4,Q5,Q6,Q7;GAS TURBINES;HYDROGEN: T8;HYDROGEN SULFIDES: T9;INCOLOY 800;MATERIALS: Q1,Q2;METALLURGICAL EFFECTS: Q8,Q9;PERFORMANCE;SILICON OXIDES: T7;STAINLESS STEEL-310;TURBINES;VALVES

G-150

ACCESSION NO. 79J0037449
TITLE ULTRASONIC INSPECTION OF GAS TURBINE SAND CASTINGS
AUTHORS UNICH, R.H. JR; SPROAT, W.H.
AUTHOR AFF GENERAL ELECTRIC CO., GREENVILLE, S
PUB DESC MATER. EVAL., V. 36, NO. 8, PP. 41-46
DATE JUL 1978
CATEGORIES EDB-360103
PRIMARY CAT EDB-360103
ABSTRACT NODULAR IRON CASTINGS HAVE BEEN EVALUATED WITH RADIOGRAPHY. THIS METHOD OF INSPECTION HAS PROVED TO BE SATISFACTORY BUT DOES HAVE SOME CHARACTERISTIC DISADVANTAGES. THESE ARE ASSOCIATED WITH HIGH COST AND LENGTHY HANDLING TIMES. OTHER METHODS OF NONDESTRUCTIVELY EVALUATING CASTINGS, SUCH AS ULTRASONIC, HAVE NOT BEEN USED EXTENSIVELY DUE TO THE NEWNESS OF THE TECHNOLOGY. ULTRASONICS DOES OFFER MANY ADVANTAGES OVER RADIOGRAPHY, PARTICULARLY IN THE AREAS OF COST AND SCHEDULING. THE EQUIPMENT NEEDED TO COMPLETELY RADIOGRAPH A LARGE 10,000 LB (4536 KG) TURBINE CASTING WOULD COST OVER $400,000. INSPECTION TIMES AND SERVICES FOR RADIOGRAPHY VARY; HOWEVER, TYPICAL COSTS FOR THIS TYPE OF CASTING COULD BE APPROXIMATED AT $2,000 TO $3,000. THE ULTRASONIC INSPECTION COSTS FOR THIS TYPE PART ARE ESTIMATED AT APPROXIMATELY $300. THE EQUIPMENT NECESSARY FOR THIS TYPE OF INSPECTION WOULD NOT EXCEED $10,000. ULTRASONICS IS ALSO A VIABLE PRODUCTION TOOL SINCE IT CAN BE USED WITH PLANNED TIMES AND MINIMUM PRODUCTION DELAYS. THE SETUP, PROCEDURES, AND PROCESSING TIMES ASSOCIATED WITH ULTRASONICS ARE ALSO GREATLY REDUCED OR NONEXISTENT AS COMPARED TO RADIOGRAPHY. ADDITIONALLY, A MINIMUM OF SAFETY HAZARDS ARE ASSOCIATED WITH THIS INSPECTION METHOD. AS A RESULT OF A RAPIDLY GROWING ULTRASONIC TECHNOLOGY AND THE ADVANTAGES DESCRIBED, AN EXTENSIVE EFFORT WAS UNDERTAKEN TO DEVELOP ULTRASONIC TECHNOLOGY FOR USE IN THE INSPECTION OF LARGE SAND CASTINGS. THE PERTINENT ACTIVITIES AND RESULTS ASSOCIATED WITH THIS PROGRAM ARE DESCRIBED.
DESCRIPTORS CASTINGS;COST;DEFECTS;DUCTILITY;GAS TURBINES: T1;IRON; TRANSDUCERS;ULTRASONIC TESTING: Q1

G-151

ACCESSION NO. 79C0037315
TITLE(MONO) HIGH-TEMPERATURE MATERIALS IN GAS TURBINES
EDITOR OR COMP SAHM, P.R.; SPEIDEL, M.O. (EDS.)
SEC REPT NO CONF-730391--
PAGE NO 408
AVAILABILITY AMERICAN ELSEVIER PUBLISHING CO., INC., 52 VANDERBILT AVENUE, NEW YORK, NY $48.95.
CONF TITLE HIGH-TEMPERATURE MATERIALS IN GAS TURBINES
CONF PLACE BADEN, SWITZERLAND
CONF DATE 12 MAR 1973
PUBL LOC ELSEVIER SCIENTIFIC PUBLISHING CO., AMSTERDAM, NETHERLANDS
DATE 1974
CATEGORIES EDB-360100
PRIMARY CAT EDB-360100

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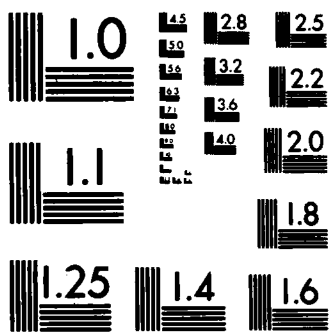
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ABSTRACT	PAPERS ARE PRESENTED ON RECENT ADVANCES IN HIGH TEMPERATURE MATERIALS FOR USE IN STATIONARY GAS TURBINES. SEVERAL OF THE PAPERS FOCUS ON MULTI-ELEMENT SUPERALLOYS.
DESCRIPTORS	ALLOYS: T2;GAS TURBINES: T1;HIGH TEMPERATURE;MATERIALS: Q1; MEETINGS: Q2;VERY HIGH TEMPERATURE

G-152

ACCESSION NO.	79C0037262
TITLE	APPLICATION OF CERAMICS TO RADIAL FLOW GAS TURBINES AT SOLAR
AUTHORS	METCALFE, A.G.
AUTHOR AFF	SOLAR DIV. OF INTERNATIONAL HARVESTER CO., SAN DIEGO, CA
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS
EDITOR OR COMP	BURKE, J.J.; GORUM, A.E.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-731191--
PAGE NO	739-747
CONF TITLE	2. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	HYANNIS, MA, USA
CONF DATE	13 NOV 1973
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1974
CATEGORIES	EDB-330103;360205
PRIMARY CAT	EDB-330103
ABSTRACT	SMALL RADICAL FLOW GAS TURBINES FOR FIELD SERVICE PRESENT SPECIAL PROBLEMS RELATED TO COMBUSTOR CONTROL AND DUST INGESTION. ANALYSES OF CERAMICS UNDER THESE SERVICE CONDITIONS INDICATED THAT CERAMIC NOZZLE GUIDE VANES AND SHROUDS WOULD PROVIDE EFFICIENT SOLUTIONS TO SUCH PROBLEMS. THE ANALYSES WERE CONFIRMED BY TESTS ON A SMALL TURBINE. IT IS SUGGESTED THAT THIS TYPE OF APPLICATION INVOLVES MUCH LESS RISK THAN THOSE REQUIRING DEVELOPMENT OF AN ALL-CERAMIC ENGINE, AND MAY REPRESENT AN EFFECTIVE APPROACH TO INTRODUCE CERAMICS TO GAS TURBINES. THESE VIEWS WILL BE ILLUSTRATED BY AN ANALYSES OF THE U.S. ARMY (MERDC) 10-KW GAS TURBINE GENERATOR.
DESCRIPTORS	AIRCRAFT;EROSION: Q3;GAS TURBINES: T1;MATERIALS: Q1;MATERIALS TESTING;SILICON NITRIDES: T2;TURBINE BLADES: T3;USES: Q2;VANES: VERY HIGH TEMPERATURE

G-153

ACCESSION NO.	79C0037260
TITLE	PROTOTYPE CERAMIC VANES
AUTHORS	NESSLER, C.G.
AUTHOR AFF	PRATT AND WHITNEY AIRCRAFT, MIDDLETOWN, CT
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS
EDITOR OR COMP	BURKE, J.J.; GORUM, A.E.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-731191--
PAGE NO	609-630
CONF TITLE	2. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	HYANNIS, MA, USA
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PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1974
CATEGORIES	EDB-330103;200104;360200
PRIMARY CAT	EDB-330103
ABSTRACT	CERAMIC VANES OFFER SIGNIFICANT POTENTIAL IN LARGE AIRCRAFT AND INDUSTRIAL GAS TURBINES. THE SUITABILITY OF HOT-PRESSED SILICON NITRIDE FOR USE IN CURRENT ENGINE VANES WAS PRELIMINARY EVALUATED. PROTOTYPE VANE CONSTRUCTION AND TESTING WERE UNDERTAKEN TOGETHER WITH CLOSELY RELATED MATERIAL CHARACTERIZATION. THE RESULTS INDICATED THAT CYCLIC THERMAL STRESS AND IMPACT BEHAVIOR ESPECIALLY WARRANT MORE ATTENTION. ESTABLISHING MATERIAL PERFORMANCE CRITERIA AND COMPARING TEST DATA WITH THEM ARE IMPORTANT NEEDS. DESIGN AND CONSTRUCTION OF EXPERIMENTAL PARTS ARE THE NECESSARY NEXT STEPS TO ACCURATELY DETERMINE THE UTILITY OF HOT-PRESSED CERAMICS.
DESCRIPTORS	AIRCRAFT;CORROSION;DESIGN;FAILURES;GAS TURBINES: T1;MATERIALS: Q2;MATERIALS TESTING;PERFORMANCE TESTING: Q2,Q3;POWER PLANTS; SILICON NITRIDES: T3;THERMAL STRESSES: Q3;USES: Q3;VANES: T2,Q1; VERY HIGH TEMPERATURE

G-154

ACCESSION NO.	79C0037259
TITLE	THERMAL RESPONSE OF CERAMIC TURBINE STATORS
AUTHORS	JOHNSON, C.F.; HARTSOCK, D.L.
AUTHOR AFF	FORD MOTOR CO., DEARBORN, MI
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS
EDITOR OR COMP	BURKE, J.J.; GORUM, A.E.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-731191--
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PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1974
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	A DESCRIPTION OF THE TEST FACILITIES USED TO EVALUATE CERAMIC TURBINE STATORS FOR A REGENERATIVE GAS TURBINE ENGINE IS PRESENTED. THE ADVANTAGES AND LIMITATIONS OF THESE TEST FACILITIES ARE PRESENTED ALONG WITH A COMPARISON OF THE TEST RESULTS. THE TECHNIQUE OF USING AN INFRARED PYROMETER TO MEASURE STATOR VAN TEMPERATURES THROUGH THE COMBUSTION SYSTEM OF A GAS TURBINE ENGINE IS DISCUSSED ALONG WITH TYPICAL TEST RESULTS. FINALLY, THE THERMAL RESPONSE DATA OF CERAMIC STATOR VANES ARE PRESENTED FOR EACH TEST SYSTEM AND COMPARED WITH THEORETICAL VALUES.
DESCRIPTORS	AUTOMOBILES;GAS TURBINES: T1;MATERIALS: Q2;MATERIALS TESTING; PERFORMANCE TESTING: Q2;PYROMETERS;SILICON NITRIDES: T3; STATORS: T2,Q1;TEMPERATURE MEASUREMENT;TEST FACILITIES;THERMAL SHOCK: Q3;VERY HIGH TEMPERATURE

G-155

ACCESSION NO.	79C0037256
TITLE	SPIN TESTING OF CERAMIC TURBINE ROTORS
AUTHORS	STYHR, K.H.
AUTHOR AFF	FORD MOTOR CO., DEARBORN, MI
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS
EDITOR OR COMP	BURKE, J.J.; GORUM, A.E.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-731191--
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DATE	1974
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	A MAJOR PORTION OF THE FORD CERAMIC TURBINE ROTOR FABRICATION PROGRAM IS DIRECTED AT A MULTIELEMENT APPROACH IN WHICH ELEMENTS OF VARIOUS COMPLEXITY AND PROPERTY REQUIREMENTS SUCH AS THE RING OF BLADES, THE HUB, THE REINFORCED PLATFORM, ETC., ARE INDIVIDUALLY FORMED AND SUBSEQUENTLY JOINED TO FORM A COMPLETE ROTOR. TESTING OF SUCH ROTORS INCLUDED A COLD SPIN TEST OF EACH ELEMENT OF THE ASSEMBLY, DESIGNED TO ESTABLISH ITS STRENGTH LEVEL WHILE PHOTOGRAPHING THE FAILURE TO ESTABLISH THE FAILURE MODE. ASSEMBLIES OF TWO OR MORE ELEMENTS JOINED OR BONDED UNDER A VARIETY OF CONDITIONS HAVE ALSO BEEN COLD SPIN TESTED DURING THE DEVELOPMENT OF THE JOINING TECHNIQUE AND THE EVALUATION OF VARIOUS DESIGN MODIFICATIONS. A WIDE RANGE OF FAILURE CONDITIONS HAVE BEEN IDENTIFIED DURING THE COLD-SPIN-TESTING PHASE, THEREBY ALLOWING THE DEVELOPMENT OF IMPROVED ROTORS SUITABLE FOR SUBSEQUENT HOT TEST AND ENGINE DEVELOPMENT.
DESCRIPTORS	AUTOMOBILES;DESIGN;FABRICATION;FAILURES;GAS TURBINES: T1; MATERIALS: Q2;PERFORMANCE TESTING: Q2;ROTORS: T2,Q1;SILICON NITRIDES: T3;USES: Q3

G-156

ACCESSION NO.	79C0037254
TITLE	PROCESSING AND FABRICATION OF NON-HOT-PRESSED SILICON CARBIDE
AUTHORS	ALLIEGRO, R.A.
AUTHOR AFF	NORTON CO., WORCESTER, MA
TITLE(MONO)	CERAMICS FOR HIGH-PERFORMANCE APPLICATIONS
EDITOR OR COMP	BURKE, J.J.; GORUM, A.E.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-731191--
PAGE NO	253-263
CONF TITLE	2. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	HYANNIS, MA, USA
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PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1974
CATEGORIES	EDB-330103;360201
PRIMARY CAT	EDB-330103
ABSTRACT	THE NEED FOR A VARIETY OF MATERIALS TO SATISFY ADVANCED GAS TURBINE REQUIREMENTS IS RECOGNIZED. THE USE OF SILICON CARBIDE COMPONENTS IN THIS ENVIRONMENT, MADE BY PROCESSES OTHER THAN HOT PRESSING, IS DISCUSSED. IN PARTICULAR, THE PROPERTIES AND PROCESSES UNIQUE TO REFEL, KT, CVD SILICON CARBIDE, AND NORALIDE NC-400 ARE DESCRIBED IN DETAIL. THE PRESENT AND POTENTIAL APPLICATION AREAS FOR THESE MATERIALS ARE ALSO DISCUSSED. SPECULATION IS MADE REGARDING IMPROVEMENTS IN THESE SYSTEMS IN THE FUTURE.
DESCRIPTORS	FABRICATION: Q1;GAS TURBINES: T2;MATERIALS: Q2;MATERIALS WORKING;MECHANICAL PROPERTIES;MICROSTRUCTURE;PHYSICAL PROPERTIES: Q1;PRODUCTION: Q1;SILICON CARBIDES: T1;USES;VERY HIGH TEMPERATURE

G-157

ACCESSION NO.	79C0037250
TITLE	PROBABILITY-BASED DESIGN AND ANALYSIS: THE RELIABILITY PROBLEM
AUTHORS	LENOE, E.M.
AUTHOR AFF	ARMY MATERIALS AND MECHANICS RESEARCH CENTER, WATERTOWN, MA
TITLE(MONO)	CERAMICS FOR HIGH-PERFORMANCE APPLICATIONS
EDITOR OR COMP	BURKE, J.J.; GORUM, A.E.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-731191--
PAGE NO	123-145
CONF TITLE	2. ARMY MATERIALS TECHNOLOGY CONFERENCE
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CONF DATE	13 NOV 1973
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1974
CATEGORIES	EDB-330103;360203
PRIMARY CAT	EDB-330103
ABSTRACT	THE GENERAL PROBLEM OF ENGINE RELIABILITY IS DISCUSSED PRIOR TO REVIEWING PROBABILITY-BASED DESIGN AND ANALYSIS TECHNIQUES. TYPICAL AIRCRAFT TURBINE ENGINE RELIABILITY GROWTH DURING EARLY SERVICE LIFE CAN INVOLVE A THREEFOLD REDUCTION IN UNSCHEDULED ENGINE REMOVAL RATES. REASONS FOR THIS CHARACTERISTIC MATURING OF RELIABILITY ARE PRESENTED. THIS MATURATION OF RELIABILITY EMPHASIZES THE IMPORTANCE OF VARIABILITY INTRODUCED BY ANALYTICAL INADEQUACIES, AS WELL AS INHERENT VARIABILITIES IN MATERIAL STRENGTH. WITH REGARD TO THE CERAMIC ENGINE APPLICATION, STATISTICAL MODELS FOR STRENGTH AND MODULUS OF HOT-PRESSED SILICON NITRIDE ARE PRESENTED AND DISCUSSED. A SPECIFIC EXAMPLE IS GIVEN OF PROBABILITY OF FAILURE COMPUTATIONS FOR DETERMINISTIC MECHANICAL AND THERMAL STRESSES IN THE FIRST-STAGE ROTOR OF THE VEHICULAR ENGINE PROJECT.
DESCRIPTORS	AIRCRAFT;FAILURES;GAS TURBINES: T1;MATERIALS: Q1;MECHANICAL PROPERTIES: Q2;RELIABILITY: Q1;ROTORS;SILICON NITRIDES: T2; THERMAL STRESSES;USES: Q2

DESCRIPTORS	ADDITIVES;DIESEL ENGINES;GAS TURBINES;HEAT ENGINES: T2;HIGH TEMPERATURE;MATERIALS: Q2;MECHANICAL PROPERTIES;PHYSICAL PROPERTIES: Q1;SILICON NITRIDES: T1;SINTERING: Q1;STIRLING ENGINES;USES: Q1

G-158

ACCESSION NO.	79C0037237
TITLE	COOLED VS UNCOOLED ADVANCED GAS TURBINE ENGINE CYCLES IN AN ARMY TANK APPLICATION
AUTHORS	HULBERT, J.K.
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770360--
PAGE NO	945-957
CONF TITLE	5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	NEWPORT, RI, USA
CONF DATE	21 MAR 1977
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	SEVEN BASICALLY DIFFERENT GAS TURBINE CYCLES WERE ANALYZED WITH THE GOAL OF EVALUATING THE POTENTIAL FOR MINIMIZING FUEL REQUIREMENTS FOR FUTURE ARMY TRACKED VEHICLES. EMPHASIS WAS ON IMPROVED EFFICIENCY FOR THE SO-CALLED BATTLE FIELD DAY SCENARIO. COMMONALITY OF COMPONENTS SUITABLE FOR A FAMILY OF ENGINES RANGING OVER 700, 1250 AND 1800 HORSEPOWER WAS AN ADDITIONAL CONSTRAINT. ONE STYLE WAS FOUND TO BE SUPERIOR TO ALL OTHERS. IT IS OBSERVED THAT DEVELOPMENT OF TURBINES WHICH ARE SIGNIFICANTLY BETTER THAN DIESEL IN SPECIFIC FUEL CONSUMPTION REQUIRE THE AVAILABILITY OF CERAMIC MATERIALS.
DESCRIPTORS	CERAMICS: T3;COOLING;DESIGN;FUEL ECONOMY: Q2;GAS TURBINES: T2,Q1;MACHINE PARTS;MATERIALS: Q2;MILITARY EQUIPMENT; PERFORMANCE;THERMODYNAMIC CYCLES: Q2;USES: Q3;VEHICLES: T1

G-159

ACCESSION NO.	79C0037236
TITLE	CERAMIC REHEAT COMBUSTOR, DEMONSTRATION OF FEASIBILITY
AUTHORS	MATUSCHAK, P.E.
AUTHOR AFF	AIRESEARCH MANUFACTURING CO., PHOENIX, AZ
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770360--
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PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	THE ROLE OF THE CERAMIC REHEAT COMBUSTOR IN AN OPTIMIZED 1800 HORSEPOWER RECUPERATIVE TANK ENGINE IS DESCRIBED. NONINTERCOOLED, AS WELL AS, INTERCOOLED REHEAT SYSTEMS WERE CONSIDERED. INTERCOOLING IMPROVES CYCLE EFFICIENCY AND ENABLES BOTH ENGINE AND FUEL VOLUME REDUCTIONS IN EXCESS OF THE VOLUME REQUIRED BY AN INTERCOOLER, THEREBY LEADING TO A MORE COMPACT ENGINE SYSTEM. RESULTS OBTAINED DURING DESIGN, ANALYSIS AND EVALUATION OF A NORTON NC-430 SLIPCAST SILICON/SILICON CARBIDE REHEAT COMBUSTOR. FEASIBILITY OF USING CERAMIC MATERIALS FOR HIGH TEMPERATURE REHEAT COMBUSTORS IS DEMONSTRATED AND RECOMMENDATIONS FOR FUTURE STUDIES ARE PROVIDED.
DESCRIPTORS	AUTOMOBILES;COMBUSTORS: T3,Q1;DESIGN;GAS TURBINES: T1; MATERIALS: Q3;PERFORMANCE TESTING: Q3;SILICON CARBIDES: T4; SILICON NITRIDES: T5;USES: Q4,Q5

G-160

ACCESSION NO.	79C0037235
TITLE	CERAMIC BLADE ATTACHMENTS
AUTHORS	CALVERT, G.S.; CARRUTHERS, W.D.
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
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DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	STUDIES UNDER WAY ON TWO CONCEPTS FOR PRODUCING A TURBINE ROTOR WITH CERAMIC BLADES AND A SUPERALLOY DISCS ARE DISCUSSED. ONE CONCEPT EMPLOYS HOT-PRESSED SILICON NITRIDE BLADES AND A COMPLIANT INTERLAYER AT THE BLADE ROOT END FITTING WHEREAS THE SECOND CONCEPT RELIES ON A SUPERPLASTIC PLASTIC FORGING TECHNIQUE TO ATTACH CERAMIC BLADES TO THE METAL DISK. THIS LATER CONCEPT HAS BEEN HOT SPIN TESTED AT 2.250$SUP 0$F AND 45,000 RPM FOR 50 H IN A VACUUM SPIN PIT. THE FULLY BLADED (30 BLADES) ROTOR SURVIVED THIS MAJOR TEST.
DESCRIPTORS	AIRCRAFT;DESIGN;FABRICATION: Q2;GAS TURBINES: T1;MATERIALS: Q2; NONDESTRUCTIVE TESTING;PERFORMANCE TESTING: Q2;ROTORS;SILICON NITRIDES: T3;STRESS ANALYSIS;TURBINE BLADES: T2,Q1;USES: Q3; VERY HIGH TEMPERATURE

G-161

ACCESSION NO.	79C0037233
TITLE	ARPA/NAVY CERAMIC ENGINE MATERIALS AND PROCESS DEVELOPMENT SUMMARY
AUTHORS	RICHERSON, D.W.; SCHULDIES, J.J.; YONUSHONIS, T.M.; JOHANSEN, K.M.
AUTHOR AFF	AIRESEARCH MANUFACTURING CO., PHOENIX, AZ
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770380--
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PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1976
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	A SUMMARY OF THE MATERIALS SELECTION AND PROCESS DEVELOPMENT CARRIED OUT UNDER THE ARPA/NAVY CERAMIC ENGINE PROGRAM IS PROVIDED. MATERIALS CHARACTERIZATION, INCLUDING EFFECTS OF MACHINERY AND OXIDATION TREATMENTS ON STRENGTH, AND ENVIRONMENTAL EFFECTS ON HPSN AND RBSN ARE PRESENTED. MANUFACTURING PROCESS DEVELOPMENT FOR ROTORS, STATORS, COMBUSTORS, AND OTHER STATIONARY COMPONENTS ARE REVIEWED. NDE TECHNIQUES USED IN THE PROGRAM ARE DISCUSSED. CURRENTLY AVAILABLE MATERIALS APPEAR TO BE ADEQUATE FOR THE PROGRAM REQUIREMENTS.
DESCRIPTORS	AIRCRAFT;BONDING;CERAMICS;FABRICATION: Q4,Q5,Q6;GAS TURBINES: T1;HOT PRESSING;MACHINING;MATERIALS;MATERIALS TESTING: Q3; MECHANICAL PROPERTIES;OXIDATION;PHYSICAL PROPERTIES: Q3; RESEARCH PROGRAMS;ROTORS: T4,Q1;SILICON NITRIDES: T3;STATORS: T5,Q1;TURBINE BLADES: T6,Q1;USES: Q3

G-162

ACCESSION NO.	79C0037227
TITLE	DEVELOPMENT OF MULTI-DENSITY SILICON NITRIDE TURBINE ROTORS
AUTHORS	WALZER, P.; LANGER, M.; SIEBELS, J.
AUTHOR AFF	VOLKSWAGENWERK AG, WOLFSBURG, GERMANY
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770380--
PAGE NO	603-614
CONF TITLE	5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	NEWPORT, RI, USA
CONF DATE	21 MAR 1977
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	THE VOLKSWAGENWERK AG IS DEVELOPING A CERAMIC TURBINE ROTOR CONSISTING OF A HOT PRESSED SILICON NITRIDE HUB AND A REACTION SINTERED SILICON NITRIDE BLADE RING. THREE DIFFERENT

FABRICATION CONCEPTS ARE BEING INVESTIGATED. AT ROOM TEMPERATURE, PROTOTYPE ROTORS HAVE ATTAINED CIRCUMFERENTIAL SPEEDS UP TO 365 M/S. SIMPLIFIED BLADE RINGS HAVE SURVIVED GAS TEMPERATURE CHANGES OF 500 K/S. AT TEMPERATURES ABOVE 1300 K, OXIDATION MAY REDUCE THE STRENGTH OF A CERAMIC COMPONENT.

DESCRIPTORS AUTOMOBILES;DESIGN;FABRICATION: Q2;GAS TURBINES: T1;MATERIALS: Q2;OXIDATION;PERFORMANCE TESTING: Q2;ROTORS: T2,01;SILICON NITRIDES: T3;THERMAL STRESSES;USES: Q3;VERY HIGH TEMPERATURE

G-163

ACCESSION NO.	79C0037226
TITLE	DEVELOPMENT OF CERAMIC PARTS FOR A TRUCK GAS TURBINE AT MTU
AUTHORS	PESCHEL, W.H.; SIEBMANNS, W.; TRAPPMANN, K.
AUTHOR AFF	MOTOREN- UND TURBINEN UNION, MUNICH, GERMANY
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.M.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770380--
PAGE NO	481-502
CONF TITLE	5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	NEWPORT, RI, USA
CONF DATE	21 MAR 1977
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	BASED ON REQUIREMENTS TO BE MET BY HOT SECTION COMPONENTS OF AN ADVANCED TRUCK GAS TURBINE, CERAMIC PARTS (FLAME TUBE, TURBINE INLET NOSE CONE, TURBINE NOZZLE AND A METAL DISC/CERAMIC BLADES TURBINE WHEEL) HAVE BEEN DESIGNED AND TESTED AT MTU MUNICH. DESCRIPTION OF PARTS DESIGN INCLUDES OPTIMIZATION STUDIES AND A SURVEY OVER CALCULATED STRESS DISTRIBUTIONS DUE TO TEMPERATURE GRADIENTS, GAS AND ATTACHMENT FORCES AT DIFFERENT GAS TURBINE OPERATING CONDITIONS. PRESENTATION OF TEST RESULTS CONCENTRATES ON FLAME TUBE AND TURBINE WHEEL TESTING. FLAME TUBES OF VARIOUS SHPAES, MADE FROM DIFFERENT MATERIALS HAVE SUCCESSFULLY BEEN TESTED. IN TURBINE WHEEL DEVELOPMENT, THE ATTACHMENT OF CERAMIC BLADES TO THE METALLIC DISC HAS EXTENSIVELY BEEN INVESTIGATED. TURBINE BLADE SPIN TEST RESULTS ARE IN GOOD AGREEMENT WITH CALCULATION RESULTS; BURST SPEEDS OBTAINED ARE WELL ABOVE THE AERODYNAMICALLY NECESSARY SPEEDS.
DESCRIPTORS	CERAMICS: T2;DESIGN;GAS TURBINES: T1;MATERIALS: Q3,04; PERFORMANCE TESTING: Q3,Q4;RESEARCH PROGRAMS;ROTORS: T4,01; SILICON CARBIDES;SILICON NITRIDES;TRUCKS;TURBINE BLADES: T3,01; USES: Q2;VERY HIGH TEMPERATURE

G-164

ACCESSION NO.	79C0037221
TITLE	RELIABILITY AND DURABILITY OF CERAMIC REGENERATORS FOR GAS TURBINE APPLICATIONS
AUTHORS	RAHNKE, C.J.; VALLANCE, J.K.
AUTHOR AFF	FORD MOTOR CO., DEARBORN, MI
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.M.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770380--
PAGE NO	335-347
CONF TITLE	5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	NEWPORT, RI, USA
CONF DATE	21 MAR 1977
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	HIGH THERMAL STRESSES AND CHEMICAL ATTACK LIMITED THE EARLY LITHIUM SILICATE REGNERATORS USED IN GAS TURBINE ENGINES TO A B$SUB 10$ LIFE OF 600. THE RESULTS OF AN ENGINEERING PROGRAM THAT WAS INITIATED IN 1973 TO DEVELOPE A REGENERATOR THAT IS CAPABLE OF A B$SUB 10$ LIFE OF 10,000 HOURS ARE PRESENTED. SINCE THEN, OVER 100,000 CORE-HOURS OF GAS TURBINE ENGINE TESTING HAVE BEEN ACCUMULATED ON NEW MATERIALS AND REGENERATOR DESIGN CONCEPTS. TWO MATERIALS, ALUMINUM SILICATE AND MAGNESIUM ALUMINUM SILICATE CONTINUE TO SHOW PROMISE OF ACHIEVING THE PROGRAM OBJECTIVE. AN ALUMINUM SILICATE CORE HAS NOW ACCUMULATED OVER 6,935 HOURS AND SHOWS LITTLE EVIDENCE OF CHEMICAL ATTACK DAMAGE.
DESCRIPTORS	ALUMINIUM ALLOYS;ALUMINIUM SILICATES;AUTOMOBILES;CERAMICS: T3; FAILURES;GAS TURBINES: T1;LITHIUM SILICATES;MAGNESIUM SILICATES; MATERIALS: Q2;PERFORMANCE TESTING: Q2;REGENERATORS: T2,01; RELIABILITY: Q2;THERMAL STRESSES: Q2;USES: Q3;VERY HIGH TEMPERATURE

G-165

ACCESSION NO.	79C0037219
TITLE	TEST AND DEVELOPMENT OF CERAMIC COMBUSTORS, STATORS, NOSE CONES, AND ROTOR TIP SHROUDS
AUTHORS	HARTSOCK, D.L.; BAKER, R.R.; HAVSTAD, P.H.; BUECHEL, J.H.
AUTHOR AFF	FORD MOTOR CO., DEARBORN, MI
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770360--
PAGE NO	291-315
CONF TITLE	5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	NEWPORT, RI, USA
CONF DATE	21 MAR 1977
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	THE EVOLUTIONARY STAGES OF DESIGN AND PROCESS CHANGES WHICH OCCURRED IN THE DEVELOPMENT OF CERAMIC STATORS FOR FORD'S MODEL 820 CERAMIC GAS TURBINE ENGINE ARE DESCRIBED. IN THE ULTIMATE DESIGN, THE OUTER SHROUD AND VANES WERE INJECTION MOLDED IN ONE SHOT TO FORM A MONOLITHIC SILICON NITRIDE STATOR WHICH ACHIEVED A DENSITY OF 2.7 GM/CC AFTER NITRIDING. ONE SUCH STATOR MET THE PERFORMANCE TARGET GOAL OF OPERATING SUCCESSFULLY FOR 175 HOURS OF STEADY STATE TESTING IN A CERAMIC STRUCTURES TEST RIG AT 1,930$SUP 0$F. ''BEST LIFES TO DATE'' ARE ALSO REPORTED FOR SEVERAL OTHER STATIONARY CERAMIC COMPONENTS WHICH ARE USED IN THE HOT GAS PATH FLOW OF FORD'S MODEL 820 ENGINE.
DESCRIPTORS	AUTOMOBILES;DESIGN: Q2;FAILURES;GAS TURBINES: T1;MATERIALS: Q2; MOLDING: Q3;PERFORMANCE: Q2;PERFORMANCE TESTING;SILICON NITRIDES: T3;STATORS: T2,Q1;TEST FACILITIES;VERY HIGH TEMPERATURE

G-166 NONE
G-167 NONE

G-168

ACCESSION NO.	79C0037216
TITLE	CERAMIC TURBINE ROTORS: ENGINE TEST AND DEVELOPMENT
AUTHORS	HAVSTAD, P.H.; CAVERLY, J.C.; BAKER, R.R.
AUTHOR AFF	FORD MOTOR CO., DEARBORN, MI
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770360--
PAGE NO	273-289
CONF TITLE	5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	NEWPORT, RI, USA
CONF DATE	21 MAR 1977
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	SEVERAL DESIGN EVALUATIONS WERE CARRIED OUT ON FORDS 820 CERAMIC GAS TURBINE ENGINE IN ORDER TO APPLY THIS TEST BED IN EVALUATING CERAMIC TURBINE ROTORS. THESE INCLUDE: MODIFICATION OF THE AIR COOLING ARRANGEMENT FOR THE BOLT SUPPORTING THE ROTORS; DEVELOPMENT OF IMPROVED LUBRICANTS FOR THE INTERFACE BETWEEN THE CERAMIC ROTOR HUB AND METAL SHAFT; AND MODIFYING THE CERAMIC FLOWPATH COMPONENTS TO ACCOMMODATE ROTORS OF DIFFERENT CONFIGURATIONS. ENGINE TEST RESULTS ARE GIVEN FOR SEVERAL CERAMIC FULL DIAMETER HUBS AND PARTIALLY BLADED ROTORS AFTER RUNNING TIMES UP TO 45 MINUTES WITH INLET TEMPERATURES UP TO 2300$SUP 0$F AND SPEEDS UP TO 50,000 RPM. ONE PARTIALLY BLADED ROTOR OPERATED SATISFACTORILY FOR 10 HOURS AT 45,000 RPM WITH INLET TEMPERATURES OF 2200$SUP 0$F TO 2300$SUP 0$F.
DESCRIPTORS	AUTOMOBILES;CERAMICS: T3;DESIGN;FABRICATION;GAS TURBINES: T1; LUBRICANTS;MATERIALS: Q2;PERFORMANCE;PERFORMANCE TESTING: Q2; ROTORS: T2,Q1;USES: Q3;VERY HIGH TEMPERATURE

G-169

ACCESSION NO.	79C0037206
TITLE	AERODYNAMIC DESIGN CONSIDERATIONS FOR CERAMIC AXIAL TURBINES
AUTHORS	GRANT, J.W.; DAVIS, D.A.
AUTHOR AFF	FORD MOTOR CO., DEARBORN, MI
TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP	BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
SEC REPT NO	CONF-770360--
PAGE NO	77-94
CONF TITLE	5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE	NEWPORT, RI, USA
CONF DATE	21 MAR 1977
PUBL LOC	BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE	1978
CATEGORIES	EDB-330103;360200
PRIMARY CAT	EDB-330103
ABSTRACT	A METHOD IS DESCRIBED TO MINIMIZE ROOT STRESSES IN CERAMIC TURBINE BLADES BY DESIGNING FOR NON-TWISTED, HELICALLY AND CENTROIDALLY STACKED BLADE SECTIONS. WHILE THIS RESULTS IN A CALCULATED EFFICIENCY PENALTY OF ABOUT ONE PERCENTAGE POINT, THE BLADES ARE FREE OF TORSIONAL SHEAR AND BENDING STRESSES THEREBY RESULTING IN A PURE TENSILE STRESS DUE TO CENTRIFUGAL LOADING. AN ANALYSIS IS ALSO PRESENTED OF THE TRADE-OFF BETWEEN RELIABILITY AND EFFICIENCY AND THE ADVANTAGE FOR A THREE-STAGE AXIAL TURBINE VERSUS A TWO-STAGE AXIAL TURBINE.
DESCRIPTORS	AERODYNAMICS;AUTOMOBILES: T1;CERAMICS: T4;DESIGN: Q3;FAILURES; GAS TURBINES: T2,Q1;MATERIALS: Q3;RELIABILITY: Q2;SILICON NITRIDES;STRESSES: Q3;TURBINE BLADES: T3;USES: Q4;VERY HIGH TEMPERATURE

G-170

ACCESSION NO. 79P0037203
PATENT NO US PATENT 4,109,772
TITLE(MONO) VEHICULAR SINGLE SHAFT GAS TURBINE ENGINE POWER SYSTEM
EDITOR OR COMP POORE, G.B.
PAT ASSIGNEE TO DEERE AND CO.
FILED DATE FILED DATE 17 OCT 1975
PAGE NO 20
DATE 29 AUG 1978
CATEGORIES EDB-330103;330602
PRIMARY CAT EDB-330103
AUGMENTATION PATENT: TRANSMISSION AND CONTROL SYSTEM
ABSTRACT A VEHICULAR GAS TURBINE ENGINE POWER SYSTEM INCLUDES AN ENGINE, AN AUTOMATIC CLUTCH, A SERVICE CLUTCH AND AN INFINITELY VARIABLE TRANSMISSION COUPLED SUCCESSIVELY ALONG A POWER TRAIN. A VEHICLE CONTROL SYSTEM CONTROLS ENGINE SPEED, TRANSMISSION RATIO, AND AUTOMATIC CLUTCH ENGAGEMENT IN RESPONSE TO OPERATOR SELECTED GROUND SPEED AND ENGINE SPEED COMMANDS AS WELL AS OTHER VEHICLE CONDITIONS. THE VEHICLE CONTROL SYSTEM OPERATES IN A MANUAL MODE TO MAINTAIN ENGINE SPEED AS COMMANDED BY AN OPERATOR OR IN AN AUTOMATIC MODE TO MAINTAIN AN ENGINE SPEED WHICH WILL MINIMIZE FUEL CONSUMPTION. THE TRANSMISSION RATIO IS CONTROLLED FOR FIXED RATE VEHICLE ACCELERATION TOWARD A COMMANDED SPEED IF SUFFICIENT POWER IS AVAILABLE. OTHERWISE GROUND SPEED IS CUT BACK TO MATCH REQUIRED POWER WITH AVAILABLE POWER. HOWEVER, GROUND SPEED CUTBACK IS LIMITED AS A SAFETY FEATURE AND DISENGAGEMENT OF THE AUTOMATIC CLUTCH PREVENTS ENGINE STALL WHEN THE ENGINE BECOMES OVERLOADED.
DESCRIPTORS AUTOMOBILES: M1;CONTROL EQUIPMENT: Q2;DESIGN;GAS TURBINES: M2,Q1;OPERATION

G-171

ACCESSION NO. 79C0037130
TITLE CERAMIC HEAT EXCHANGER APPLICATIONS AND DEVELOPMENTS
AUTHORS PIETSCH, A.; STYHR, K.
TITLE(MONO) CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
EDITOR OR COMP BURKE, J.J.; LENOE, E.N.; KATZ, R.N. (EDS.)
SEC REPT NO CONF-770380--
PAGE NO 365-395
CONF TITLE 5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE NEWPORT, RI, USA
CONF DATE 21 MAR 1977
PUBL LOC BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE 1978
CATEGORIES EDB-320304;200105;360200
PRIMARY CAT EDB-320304
ABSTRACT THE POTENTIAL FOR USING CERAMIC HEAT EXCHANGERS TO RECOVER WASTE HEAT IN SELECTED INDUSTRIAL PROCESSES AND IN THE DIRECT COMBUSTION OF COAL IS DISCUSSED. RESULTS RECENTLY ACHIEVED ON TWO EXPERIMENTAL PROGRAMS WHICH ARE EVALUATING SILICON CARBIDE TUBES IN HEAT EXCHANGER APPLICATIONS ARE ALSO DESCRIBED.
DESCRIPTORS CERAMICS;CORROSION;FLUE GAS;GAS TURBINES;HEAT EXCHANGERS;HEAT RECOVERY EQUIPMENT: T3,Q1,Q2;INDUSTRIAL PLANTS: T2;MATERIALS: Q3;MATERIALS TESTING: Q5;PERFORMANCE TESTING: Q3;SILICON CARBIDES: T5;THERMAL POWER PLANTS: T1;USES: Q5;VERY HIGH TEMPERATURE;WASTE HEAT

G-172

ACCESSION NO. 79C0037123
TITLE NEW MAINTENANCE CONCEPT APPLIED IN THE DESIGN OF A NEW INDUSTRIAL GAS TURBINE IN THE 100 MW CLASS
AUTHORS THOREN, T.E.
TITLE(MONO) GAS TURBINES: STATUS AND PROSPECTS
SEC REPT NO CONF-760274--
PAGE NO 81-90
CONF TITLE SYMPOSIUM ON GAS TURBINES--STATUS AND PROSPECTS
CONF PLACE LONDON, UK
CONF DATE 4 FEB 1976
PUBL LOC INSTITUTION OF MECHANICAL ENGINEERS, BURY ST. EDMUNDS, ENGLAND
DATE 1976
CATEGORIES EDB-320303
PRIMARY CAT EDB-320303
ABSTRACT SECOND GENERATION INDUSTRIAL GAS TURBINES WILL HAVE ADVANCED PERFORMANCE DATA TO FIT FUTURE HIGH FUEL COSTS. EQUALLY IMPORTANT IS THAT AVAILABILITY IS HIGH. A DURABLE, WELL ANALYZED DESIGN WITH PROVISIONS FOR QUICK REPAIRS SHOULD YIELD

G-173

ACCESSION NO. 79C0036742
REPORT NO,PAGE EPRI-EM--718-W PP. 73-82
TITLE DISTRICT HEATING USING WASTE HEAT FROM CLOSED-CYCLE GAS TURBINES
AUTHORS YAMPOLSKY, J.S.
AUTHOR AFF GENERAL ATOMIC COMPANY, SAN DIEGO, CA
TITLE(MONO) WORKSHOP PROCEEDINGS: DUAL ENERGY USE SYSTEMS
EDITOR OR COMP DOUGHERTY, D.A. (ED.)
SEC REPT NO CONF-7709152--
PAGE NO 73-82
CONF TITLE WORKSHOP ON DUAL ENERGY USE SYSTEMS
CONF PLACE YARMOUTH, ME, USA
CONF DATE 19 SEP 1977
DATE MAY 1978
CATEGORIES EDB-290600;200105;320603
PRIMARY CAT EDB-290600
REPORT NO EPRI-EM--718-W
ABSTRACT NATURAL GAS WAS ADAPTED FOR RESIDENTIAL AND COMMERCIAL HEATING THROUGHOUT THE U.S. JUST PRIOR AND AFTER WORLD WAR II, WHEN THE SUPPLY WAS PLENTIFUL AND THE COST WAS LOW AT THE WELLHEAD; DISTRICT HEATING WOULD HAVE THE SAME POTENTIAL NOW IF A PLENTIFUL, INEXPENSIVE SUPPLY OF HEAT WERE AVAILABLE. THE CLOSED-CYCLE GAS TURBINE, WITH EITHER A NUCLEAR OR COAL HEAT SUPPLY, MEETS THIS OBJECTIVE. IT CAN PRODUCE POWER AT HIGH THERMAL EFFICIENCIES AND AT CAPITAL AND FUEL COSTS COMPETITIVE TO PRESENT-DAY LARGE CENTRAL STATION PLANTS WHILE SUPPLYING LARGE AMOUNTS OF HEAT FOR DISTRICT HEATING WITH NO ADDITIONAL FUEL AND MINIMAL ADDITIONAL CAPITAL COSTS. FURTHERMORE, THIS POWER-CONVERSION SYSTEM PROVIDES HEAT AT A TEMPERATURE SUFFICIENTLY ELEVATED SO THAT IT CAN BE UTILIZED FOR AIR CONDITIONING IN THE SUMMER AS WELL AS REDUCING TO A MINIMUM THE SIZE OF PIPING REQUIRED IN ITS TRANSMISSION AND DISTRIBUTION

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DIESEL ENERGY CONVERSION SYSTEMS

Analysis

Enough information was gathered to allow the determination of the efficiency of the diesel engine, the efficiency of the diesel power system, acquisition cost of the diesel engine, the acquisition cost of the diesel power system, lowest expected diesel engine weight, average weight of the diesel engine, total weight of the diesel power system, volume of the diesel engine, and volume of the diesel power system. The data sets used in these analyses are reported in Table 7.

Applying the least squares analysis technique to these data sets resulted in the following functions relating the systems' size and these parameters.

Diesel Engine Efficiency (DEF)

$$DEF = 2.8977 \times 10^{-1} + 9.3745 \times 10^{-3} (\log x)^2 \quad (11)$$

where x = size in kW

Standard Deviation = 2.230×10^{-2}

Diesel Energy Conversion System Efficiency (DPSE)

$$DPSE = 2.4570 \times 10^{-1} + 3.3700 \times 10^{-2} (\log x) \quad (12)$$

Standard Deviation = 1.520×10^{-2}

Diesel Engine Acqusition Cost (DEAC)

$$DEAC = 1.6391 \times 10^3 - 1.1393 \times 10^3 (\log x) + 2.2016 \times 10^2 (\log x)^2 \quad (13)$$

Standard Deviation = 1.087×10^2

The Installed Cost of the Diesel Power System (TSC)

$$TSC = 3.7202 \times 10^3 - 7.5163 \times 10^2 (\log x) \quad (14)$$

Standard Error = 2.340×10^2

Lowest Expected Diesel Engine Weight (LEW)

$$LEW = 8.4220 \times 10^1 - 5.3861 \times 10^1 (\log x) + 9.4000 (\log x)^2 \quad (15)$$

Standard Deviation = 2.400

The Average Weight of the Diesel Engine (AWD)

$$AWD = 1.2554 \times 10^2 - 7.8586 \times 10^1 (\log x) + 1.2992 \times 10^1 (\log x)^2 \quad (16)$$

Standard Deviation = 7.100

Table 7. DATA USED IN STATISTICAL ANALYSIS FOR DIFFERENT PARAMETERS OF THE TURBOCHARGED 31 DIESEL ENERGY CONVERSION SYSTEMS

Power System Size, kW	Diesel Engine Efficiency	Diesel Power Efficiency	Aquisition Cost of Diesel Engine $/kW	Installed Cost of Diesel Power System, $kW	Lowest Expected Weight of the Diesel Engine+ lbs/kW	Average Expected Weight of the Diesel Engine+ lbs/kW	Weight of the Total Diesel Power System+ lbs/kW	Diesel Engine+ Volume, lbs/kW	Diesel Power+ Volume, lbs/kW
2	----	----	----	----	----	117	----	----	----
5	----	----	1027	----	----	70	----	----	----
10	----	0.275	637	----	42	51	135	0.70	2.55
20	----	----	----	----	31	37.5	92.5	0.52	2.05
50	----	0.285	----	----	15	27.5	73	0.35	1.50
75	----	0.301	----	----	----	----	----	----	----
100	----	-----	----	2350	12	22.5	57	0.30	0.90
108	----	0.307	----	----	----	----	----	----	----
140	----	0.339	----	----	----	----	----	----	----
175	----	0.317	----	----	----	----	----	----	----
200	0.347	0.321 & 0.329	127*	----	10	16.0	40	0.25	0.75
220	----	0.348	----	----	----	----	----	----	----
230	----	0.338	----	----	----	----	----	----	----
440	----	0.348	----	----	----	----	----	----	----
500	----	----	----	----	9.4	11.0	30.0	0.20	0.60
580	----	0.361	----	----	----	----	----	----	----
670	----	0.354	----	----	----	----	----	----	----
750	----	----	----	----	8.8	10.5	27.0	0.19	0.58
800	----	0.332	----	----	----	----	----	----	----
820	0.350	0.324	----	----	----	----	----	----	----
900	0.350	0.324	123*	----	----	----	----	----	----
1000	----	----	----	----	9	10.0	26.0	0.18	0.57
1070	----	0.333	----	----	----	----	----	----	----
1100	----	0.351	----	----	----	----	----	----	----
1120	0.410	----	----	----	----	----	----	----	----
1405	----	----	362*	1250	----	----	----	----	----
1500	----	----	293*	1118	----	----	----	----	----
2000	0.400	----	350	----	9	10.7	29.0	----	----
3000	----	----	----	----	----	----	----	0.17	0.55
5000	0.400	----	320	----	11.6	13	30.0	0.16	0.54
10,000	0.450	----	----	900	12.5	18	30.0	0.15	0.53

*assuming generator cost is 10% of the (generator and engine) cost.

+selected from plotting the available data and visually drawing a curve through it which represents average values for each case and then reading the values from the curve.

The Total Weight of the Diesel Power System (TWS)

$$TWS = 2.3918 \times 10^2 - 1.3201 \times 10^2 (\log x) + 2.0230 \times 10^1 (\log x)^2 \qquad (17)$$

Standard Deviation = 5.100

Volume of the Diesel Engine (VDE)

$$VDE = 1.1738 - 6.075 \times 10^{-1} (\log x) + 8.9900 \times 10^{-2} (\log x)^2 \qquad (18)$$

Standard Deviation = 3.070×10^{-2}

Volume of the Diesel Power System (VDPS)

$$VDPS = 4.7218 - 2.5974 (\log x) + 3.9460 \times 10^{-1} (\log x)^2 \qquad (19)$$

Standard Deviation = 1.054×10^{-1}

Predicted values based on Equations 11 through 19 at different sizes are shown in Table 8. Equations 11 through 19 are also plotted along with the corresponding data in Figures 8 through 16, respectively.

Information on other diesel power system parameters such as start-up and shutdown times, operation and maintenance cost, lifetime and time between major overhauls is scarce and not enough to allow meaningful statistical analysis. Consequently, a judgement is made based on the information available for these parameters, and the results are stated below.

Start-up Time

From cold start to full load = 60-180 sec. (Depending on ambient conditions)

From stand-by position = 5-10 sec.

Shutdown Time

Cool-down time to ambient = 300 sec.

Shutdown time = 2 sec.

Table 8. VALUES OF THE DIFFERENT TURBOCHARGED DIESEL PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

Power System Size, kW	(Equation 11) Diesel Engine Efficiency (± 0.022)	(Equation 12) Diesel Power System Efficiency (± 0.015)	(Equation 13) Aquisition Cost of the Diesel Engine, $/kW (± 108.7)	(Equation 14) Installed Cost of the Diesel Power System $/kW (± 234)	(Equation 15) Lowest Expected Diesel Engine Weight, lbs/kW (± 2.4)	(Equation 16) Average Weight of Diesel Engine lbs/kW (± 7.1)	(Equation 17) Total Weight of Diesel Power System lbs/kW (± 5.1)	(Equation 18) Volume of the Diesel Engine ft^3/kW (± 0.03)	(Equation 19) Volume of the Diesel Power System ft^3/kW (± 0.11)
1.5	0.29	0.25	1445	3588	75	112	217	1.07	4.28
5.0	0.29	0.27	950	3195	51	77	156	0.79	3.10
20.0	0.31	0.29	529	2742	30	45	102	0.54	2.01
30.0	0.31	0.30	437	2610	25	38	88	0.47	1.75
60.00	0.32	0.31	309	2384	18	27	68	0.38	1.35
100.0	0.33	0.31	241	2217	14	20	56	0.32	1.11
250.0	0.34	0.33	173	1918	9	12	39	0.23	0.76
750.0	0.37	0.34	183	1559	7	7	27	0.17	0.52
1000.0	0.37	0.35	203	1465	7	7	25	0.16	0.48
5000.0	0.42	0.37	437	940	14	13	28	0.16	0.51

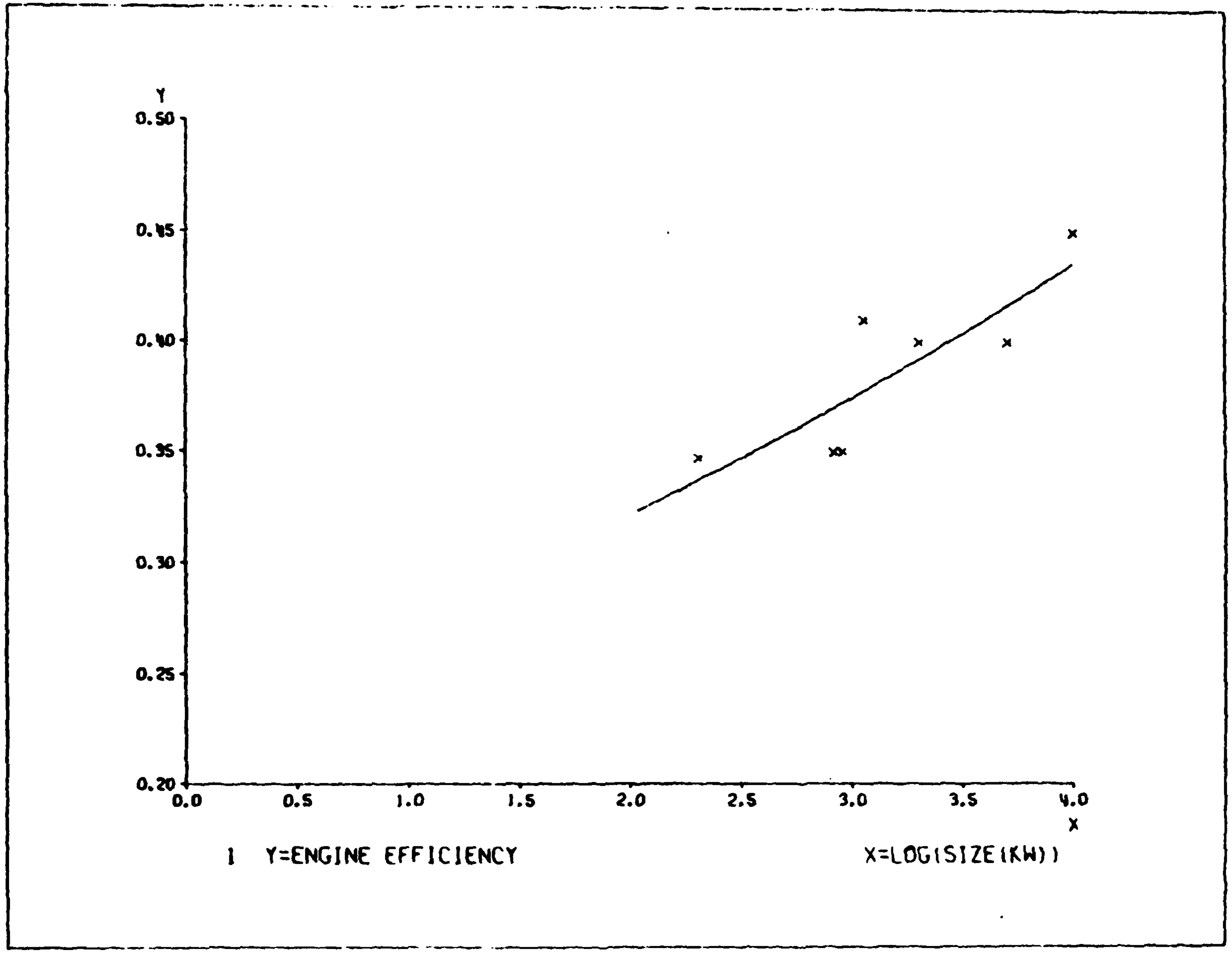

Figure 8. DIESEL ENGINE EFFICIENCY VERSUS SIZE

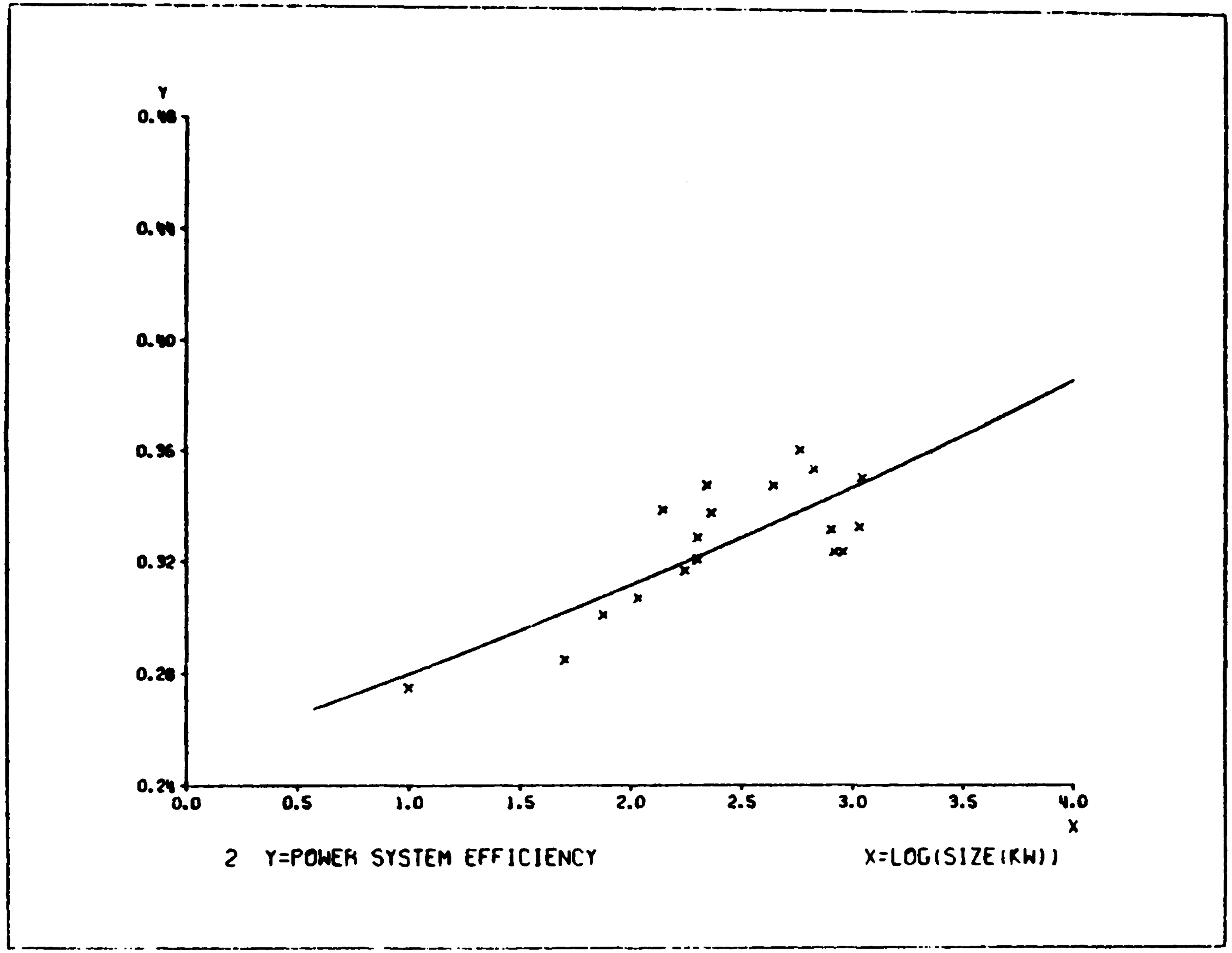

Figure 9. DIESEL ENERGY CONVERSION SYSTEM EFFICIENCY VERSUS SIZE

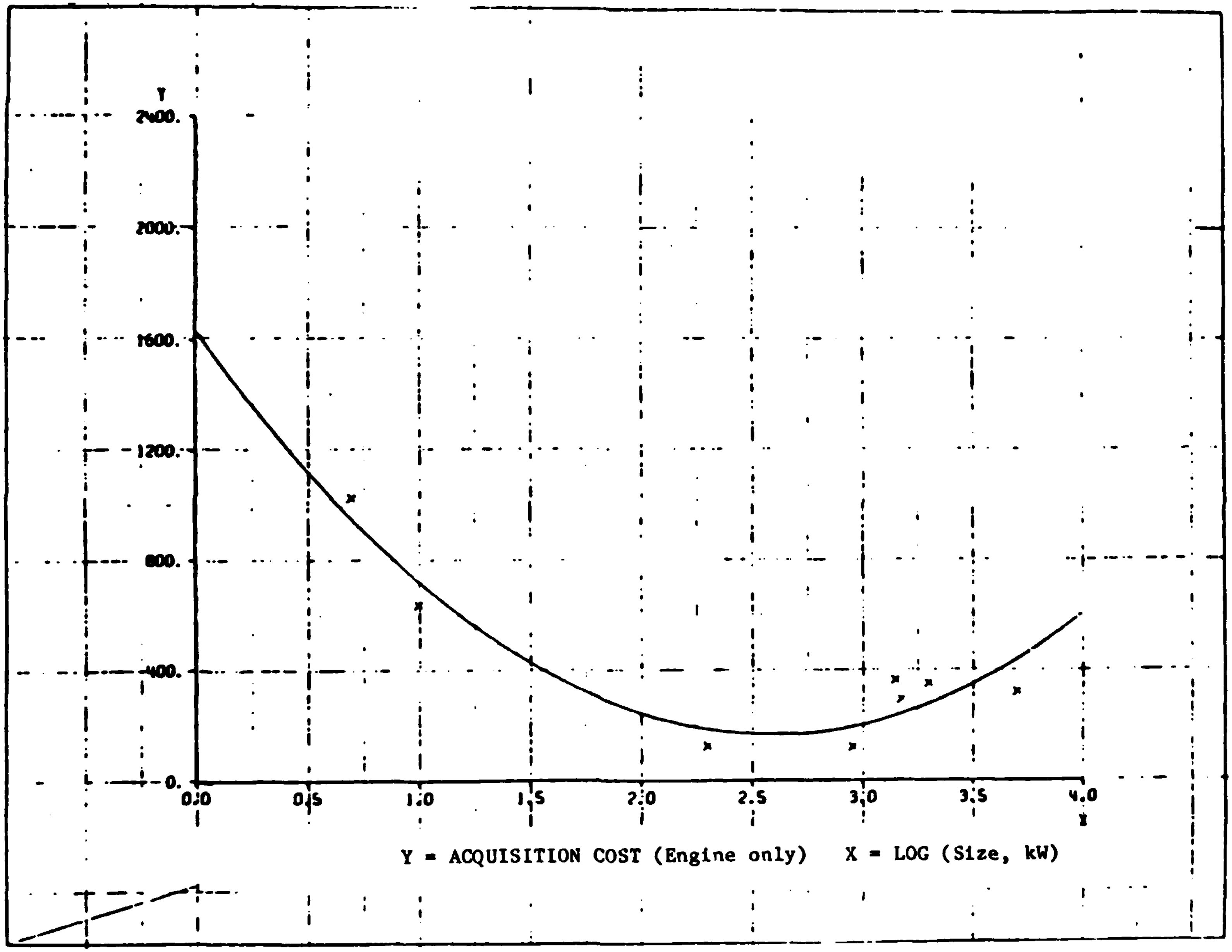

Figure 10. DIESEL ENGINE ACQUISITION COST VERSUS SIZE

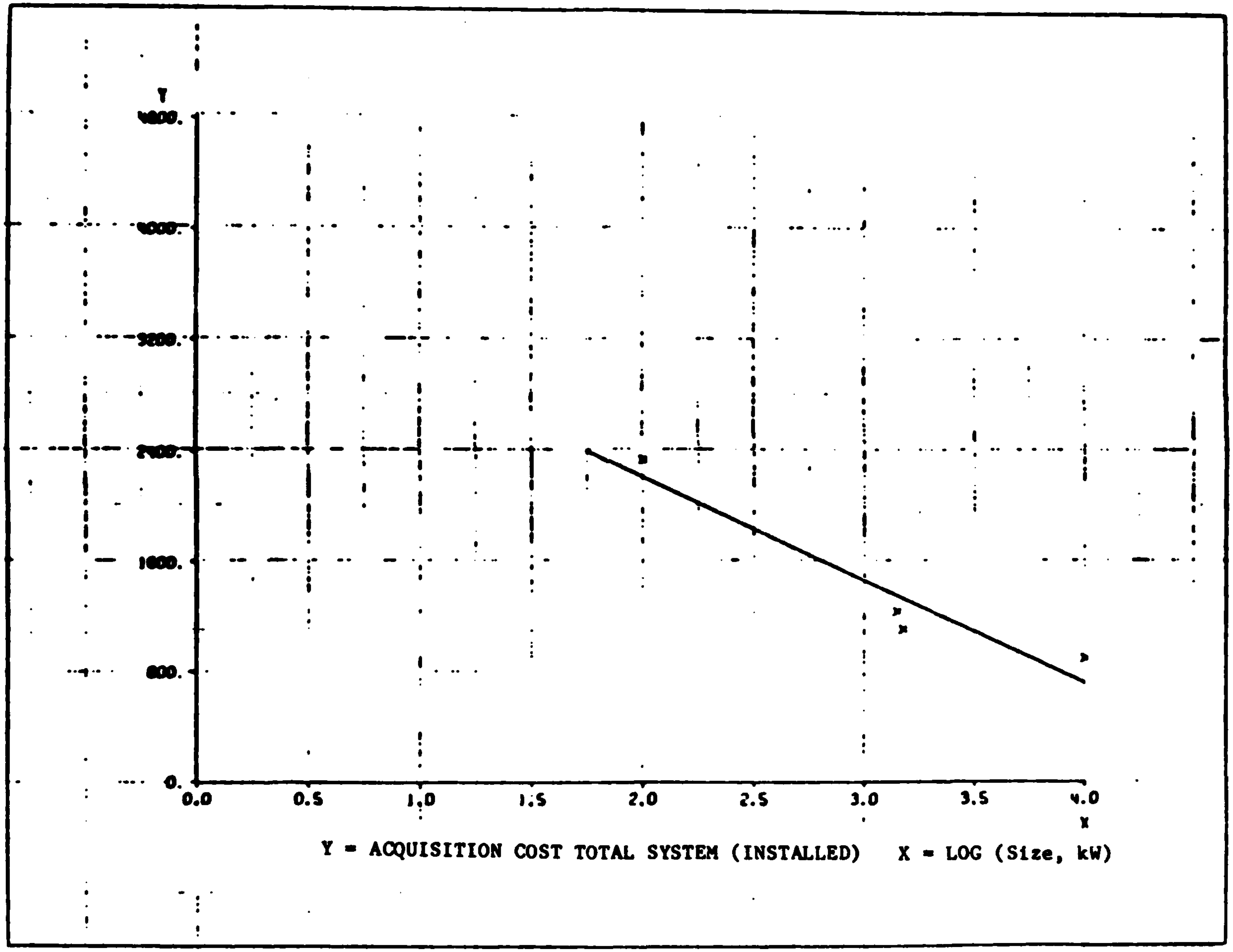

Figure 11. DIESEL ENERGY CONVERSION SYSTEM TOTAL INSTALLED COST VERSUS SIZE

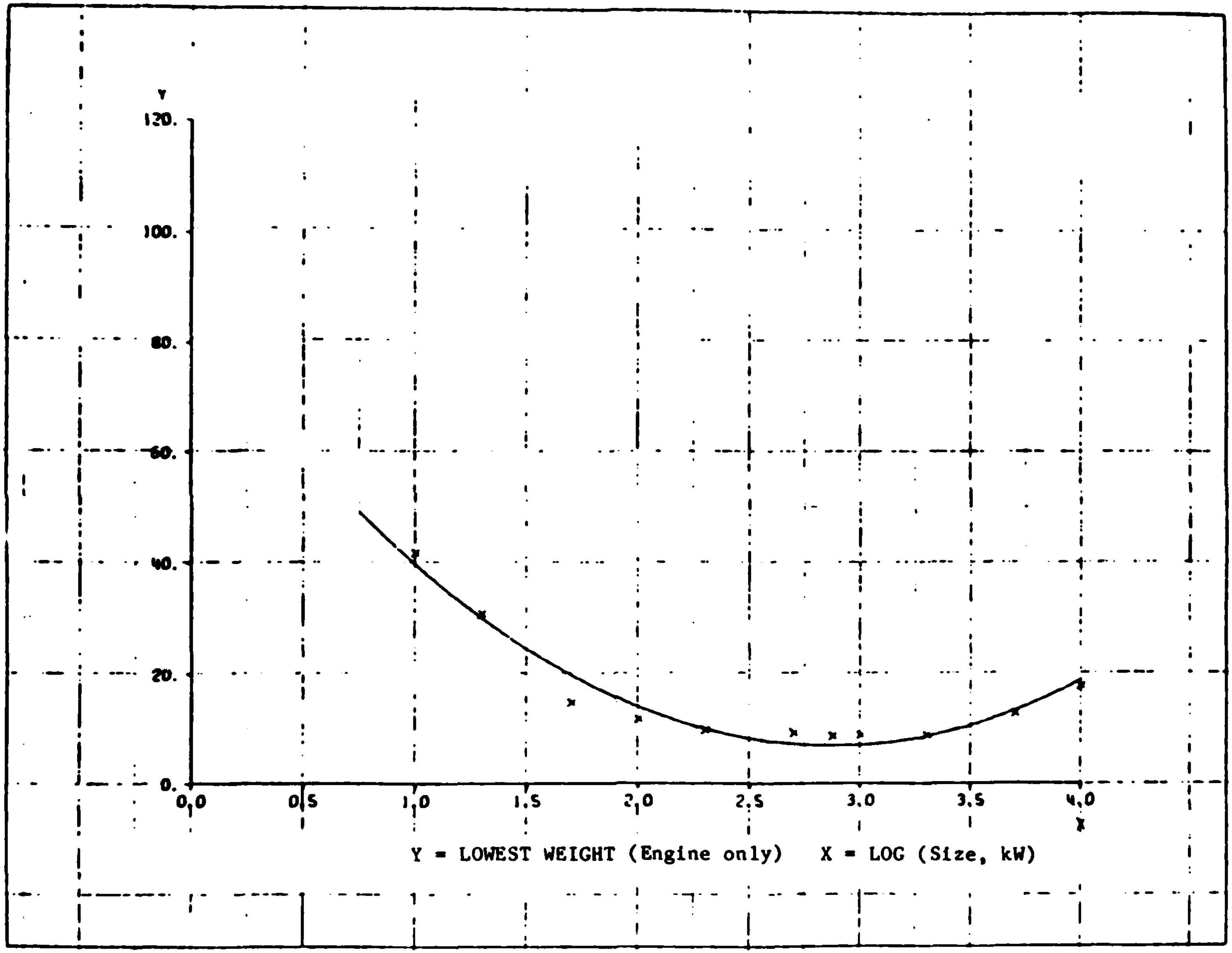

Figure 12. DIESEL ENGINE LOWEST WEIGHT VERSUS SIZE

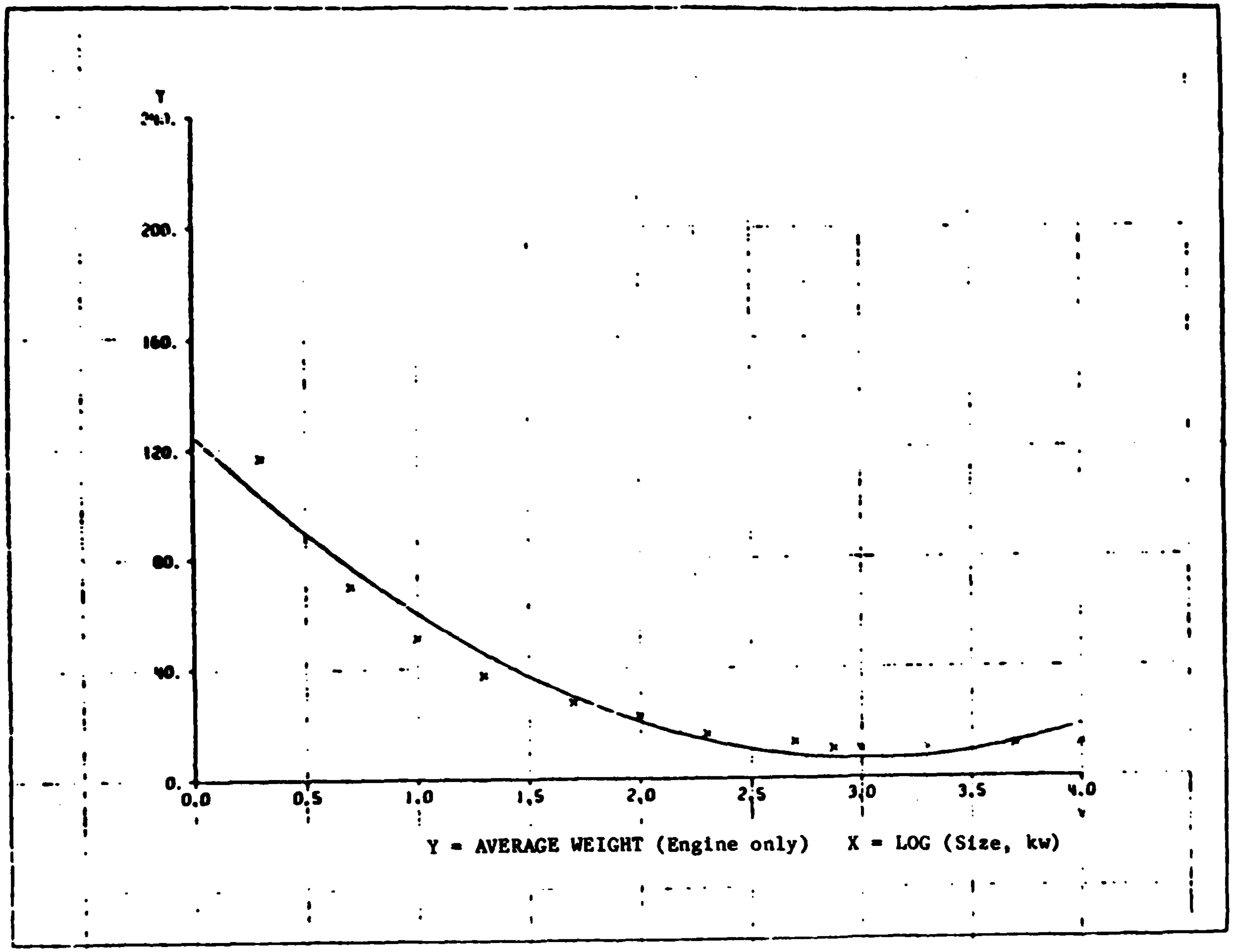

Figure 13. DIESEL ENGINE AVERAGE WEIGHT VERSUS SIZE

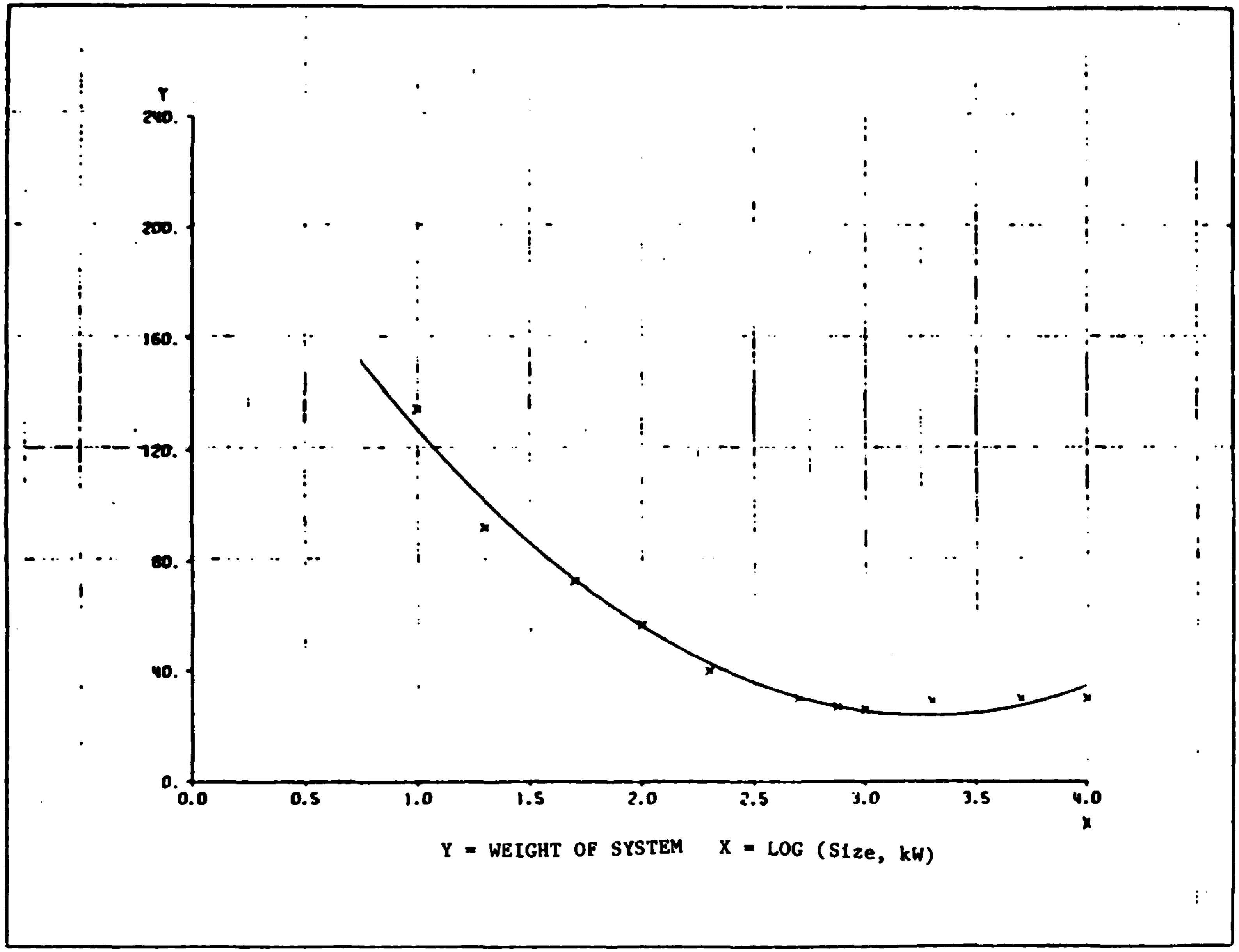

Figure 14. WEIGHT OF DIESEL ENERGY CONVERSION SYSTEM VERSUS SIZE

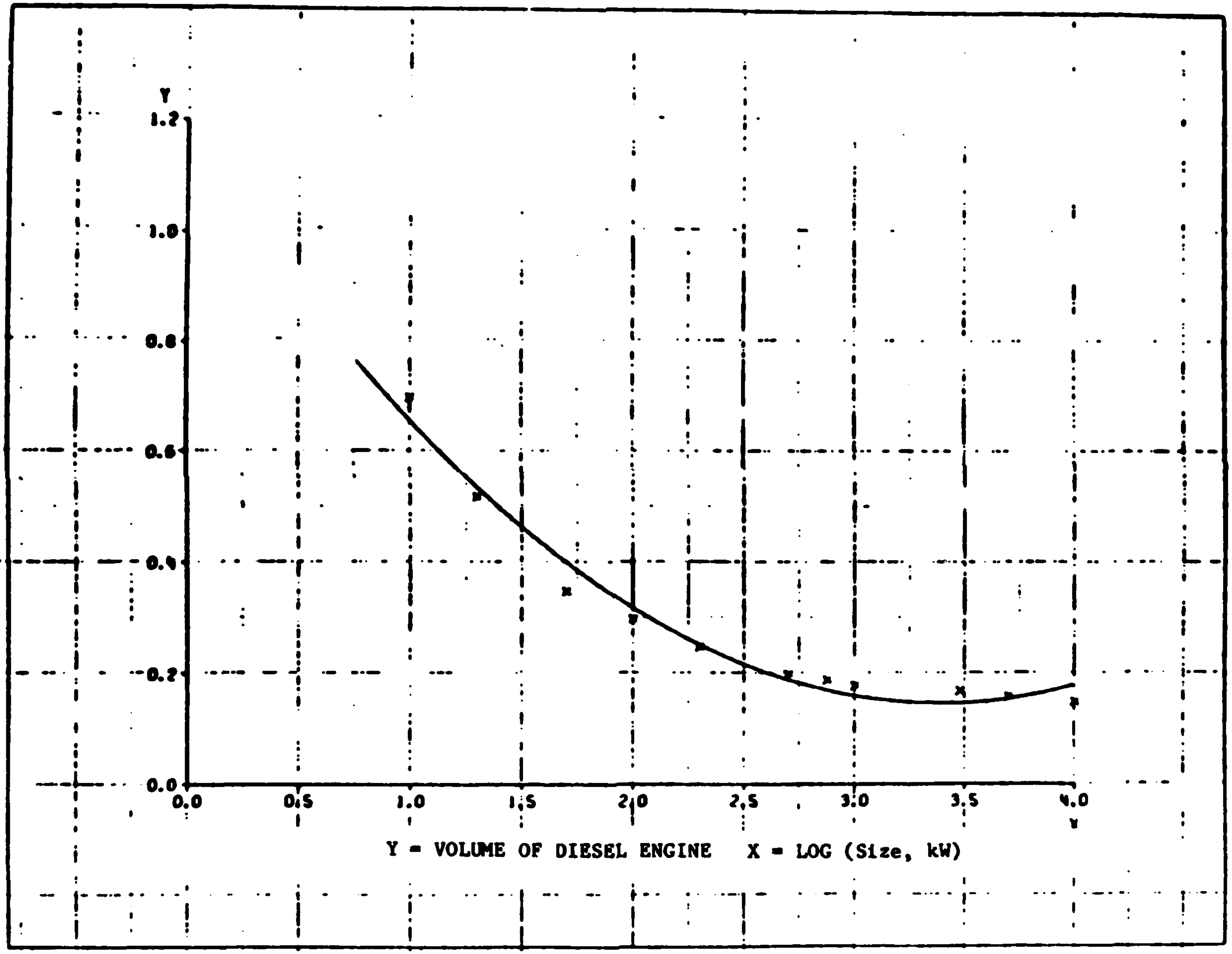

Figure 15. DIESEL ENGINE VOLUME VERSUS SIZE

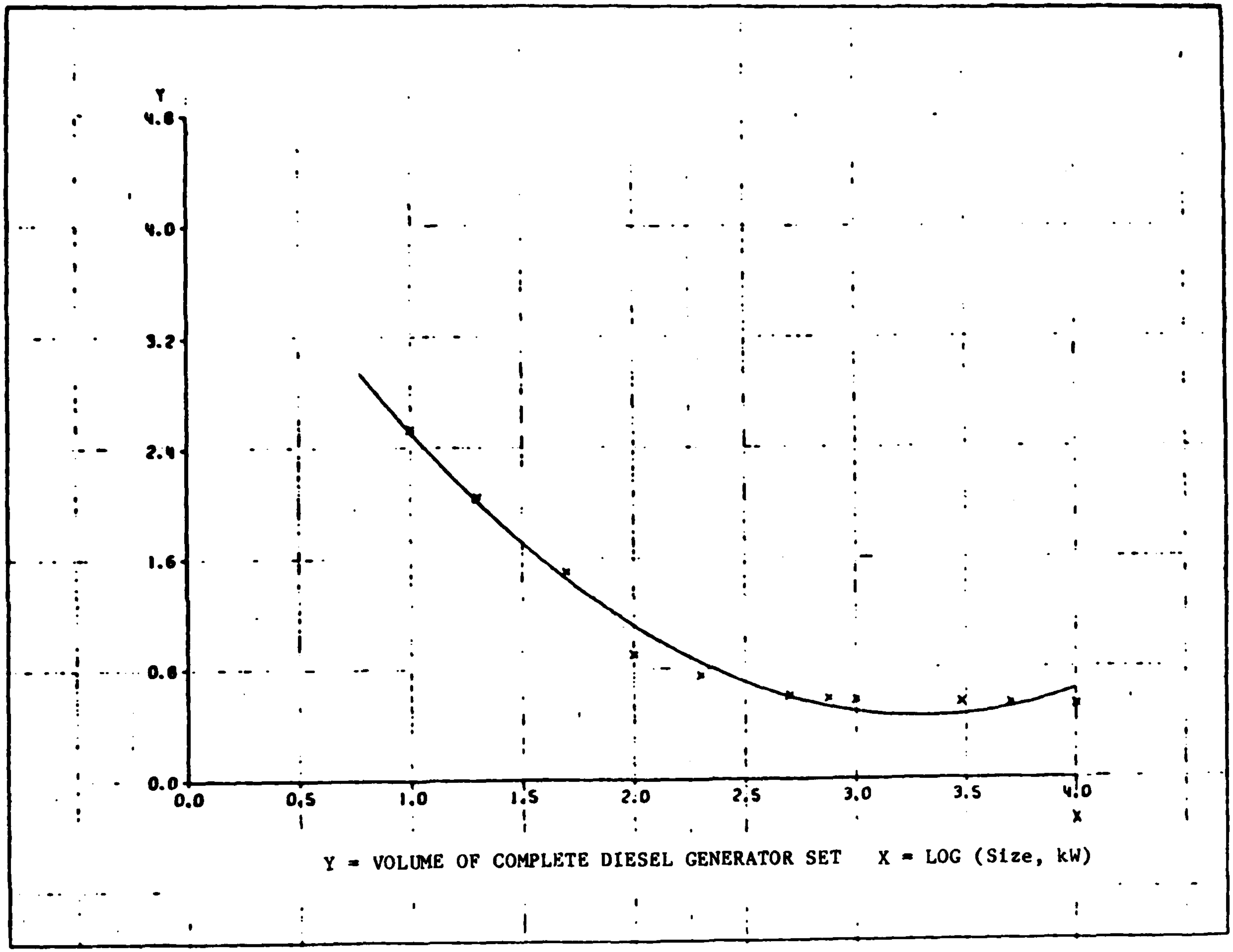

Figure 16. DIESEL ENERGY CONVERSION SYSTEM VOLUME VERSUS SIZE

Operation and Maintenance Cost

The values are in the range of 0.15 to 1.5 mills/kWHr. However, as of now, not enough information is available to determine the O&M cost as a function of plant size, plant age, and frequency of start/stop.

Lifetime

The average operational lifetime of a diesel engine is expected to be about 20 operating years. During that period it requires about four major overhauls. Time between major overhauls is 10,000 to 30,000 hours. The exact lifetime and the exact number of required overhauls depends on many factors among which are:

(1) Start/stop frequency

(2) Environmental effects such as weather and dust loading of the air

(3) Manufacturing specifications.

Mobility

Systems of less than 1 MW sizes are mobile. Systems up to about 10 MW are transportable as major blocks. Reconnection of these blocks is required at the site.

Other Energy Production

Thermal energy can be recovered from the engine's jacket cooling water in the form of hot water which may be used for district heating. Thermal energy may be recovered also from the engine's exhaust in the form of saturated or superheated steam which may be used for different applications in addiition to district heating.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 9, 10, 11, and 12, respectively.

Table 9. DIESEL ENERGY CONVERSION SYSTEM LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirement	---	Only for water cooled systems and amount required is small
2. Manning Requirements	---	Fully automated, require minimum attention and normal inspection
3. Fuel Availability and Delivery	●	Diesel uses liquid fuels which are becoming more expensive and may be in short supply in the future. Delivery is normally by trucks which is effected by weather and road conditions
4. Fuel Storage	●	Adequate storage is required especially in remote areas due to availability and delivery problems
5. Other	O	Metropolitan siting could be a problem mainly because of noise and the emission of cancer causing chemicals which may be absorbed on the particulate emissions

Overall Assessment: The ordinal score is 3 indicating average locational constraints.

75(3)/RPE/61045Q

Table 10. DIESEL ENERGY CONVERSION SYSTEM OPERATION CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability	0	Part-load operation on most models possible. However, the efficiency is slightly reduced at part-loads
2. Overload Capability	0	Overloading is possible but not recommended on prolonged basis. It also reduces the efficiency
3. Load Following Capability	0	Delayed response. Frequent, rapid load changes reduces the life of the system

Overall Assessment: The ordinal score is 4 indicating moderate turn-down capability, moderate efficiency penalty.

75(3)/RPE/61045Q

Table 11. DIESEL ENERGY CONVERSION SYSTEM RELIABILITY

Constraint	Effect	Remarks
1. Moving Parts	●	Major; contains numerous moving parts
2. Operating Temperature	0	Minor; operates at moderately high temperatures
3. Modularity of the Design	●	Major; system is non-modular. A component failure could result in a total shutdown
4. Stress Levels	0	Minor
5. Corrosion	0	Minor
6. Other	0	Thermal cycling

Overall assessment: The ordinal score is 3 indicating average reliability.

75(3)RPE/61045Q

Table 12. DIESEL ENERGY CONVERSION SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	●	—	—	Limited to vicinity. May be water or air cooled. Small amounts of make up is required when a closed cooling loop is attached
• Air Pollution				
CO	o	o	o	
NO_x	●	o	o	More severe at higher operating temperatures
SO_x	●	—	●	Depends on S content of the fuel
HC	●	●	●	Many of these are suspected of being carcinogens
Particulates	o	o	●	Depends of fuel and operating conditions and carcinogen HC may be absorbed on it
Others	—	—	—	
• Noise	●	●	●	
• Odor	o	o	o	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 4 indicating moderate potential environmental constraint.

75(3)/RPE/61045Q

DIESEL ENERGY CONVERSION SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 19	45		2(10,000)	Maximum-Low speed - marine diesel units
D. 32	80		4000-6000	Isentropic value
D. 68	41			Fuel to shaft power
D. 84	35		820	Gas engine-Cooper Energy Services Superior 8GTL
D. 49	26-36			Car-Engine 100% load
	20-35			25% load
	18-32			10% load
D. 54		41	1120	BVM 628 model, 8 cylinder
D. 69	36			Typical value
D. 57	34			
D. 64	39			
D. 39		38.8		Based on Caterpillar engine model #D-334 using #2 Diesel oil.
D. 43		38.0		Sulzer Engine Model 8-ASL-25/30 burning #6 fuel oil.
		32.0		Superior Engine Model 40-X-16 burning #6 fuel oil
D. 90		40	2000	
D. 90		40	5000	
D. 96		32.1 32.4	200 900	Include engine, generator, radiator fan at rating

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (Continued)

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
Calculated from sales brochures provided by manufacturers in response to questionnaires		0.301	75	
		0.307	108	
		0.339	140	
		0.317	175	
		0.329	250	
		0.348	220	
		0.338	230	
		0.348	440	
		0.361	580	
		0.354	670	
		0.332	800	
		0.333	1070	
		0.351	1170	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 19	3.15		10,000	
D. 64	0.24			
D. 58		0.11	96.9	"ERDA Car"
D. 16		4.25	10	
D. 16		6.94	5	
D. 91		0.82	200	60 HZ-stand-by operation-shipping volume
		0.75	285	
		0.78	420	
		0.73	560	
		1.17	765	
		1.57	800	
		1.44	1040	
		1.86	1050	
		1.04	235	
D. 92		0.44	2100	16-251 - F model
		0.40	2310	
		0.35	2675	
		0.41	2250*	
		0.37	2500*	
		0.32	2950*	
		0.54	1675	
		0.53	1720	
		0.46	2000	
		0.51	1800*	
		0.49	1865*	
		0.41	2200	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value: Study	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 92		0.38	2000	
		0.34	2200*	
		0.60	1250	
		0.58	1300	
		0.48	1575	
		0.43	1750	
		0.51	1460*	
		0.50	1500*	
		0.41	1825	
		0.37	2020*	
		0.57	1320	
		0.51	1460	
		0.50	1500	
		0.45	1675	
		0.54	2050	
		0.52	2100	
		0.43	2550	
		0.39	2800	
		0.49	2250	
		0.47	2350	
		0.39	2830	
		0.35	3135	
		0.64	830	
		0.61	860	
		0.51	1040	
		0.46	1160	
		0.59	900*	
		0.57	930I	
		0.47	1125*	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 92		0.42	1250*	
		0.67	800	
		0.62	865	
		0.53	1000	
		0.63	850*	
		0.57	935*	
		0.49	1100*	
		0.78	635	
		0.75	660	
		0.62	800	
		0.71	700*	
		0.68	725*	
		0.58	850*	
D. 94		0.99	75	Diesel Generator set-MWM Murphy 60 HZ with Turbochanging
		0.74	100	
		0.68	135	
		0.72	150	
		0.64	200	
		0.52	250	
		0.82	90*	
		0.64	115*	
		0.55	165*	
		0.62	173*	
		0.56	230*	
		0.45	288*	
		1.14	10,700	Fairbanks-Morse Engine Division. Stationary Engines "Doe not mention turbochanging"
		1.27	12,840	
		1.48	14,980	
		1.57	17,120	
		1.66	19,260	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D, 94		0.61	140	Detroit Diesel Allison Engines. Stand-by Electric Set Generator Sets. Turbocharged
		0.49	220	
		0.47	290	
		0.53	335	
		0.42	440	
		0.44	580	
		0.63	670	
		0.57	800	
		0.57	825	Jacket Water Intercooler
		0.51	1070	
		0.51	1100	Jacket Water Intercooler
		0.26	355	Dentz KHD Diesels, turbo-charged, All with charge air cooling
		0.22	475	
		0.22	710	
		0.20	950	
		0.40	825	
		0.36	1100	
		0.33	1650	
		0.29	2200	
		0.29	1170	
		0.29	1560	
		0.28	1755	
		0.27	2340	
		0.28	3120	
		0.16	3795	
		0.15	4430	
		0.15	5060	
		0.14	5695	
		0.77	2470	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 94		0.62	3295	
		0.59	4940	
		0.57	6590	
		2.66	625	Bombardier Inc. Turbo-charged Diesel
		2.16	780	
		1.65	1040	
		1.44	1400	
		1.39	1575	
		1.20	2100	
		1.09	2550	
		2.42	685*	
		1.86	910*	
		1.52	1130*	
		1.26	1595*	
		1.20	825*	
		1.11	2260*	
		0.97	2850*	
		1.74	700	Stewart-Stevenson Does not mention Turbocharging
		1.29	1075	
		1.12	1400	
		1.32	1100	
		1.00	1650	
		0.86	2200	
		0.85	2250	
		0.81	2580	
		0.78	2700	
		0.99	650	Housed units
		1.93	800	
		1.60	1000	
		2.79	1650	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 94		2.35	1650	
		2.16	2500	
		3.07	30	For Airline ground use
		1.92	48	
		1.53	60	
		1.28	72	
		0.74	4860	Grandi Motsri Trieste-Turbocharged Diesel
		0.69	6075	
		0.66	7290	
		0.60	8505	
		0.58	9780	
		0.57	10,935	
		0.57	12,150	
		0.36	880	Brons Industrie Turbo-charged Diesel
		0.32	990	
		0.29	1100	
		0.32	1175	
		0.29	1325	
		0.26	1470	
		0.29	1760	
		0.25	1990	
		0.23	2200	
		0.14	2350	
		0.13	2650	
		0.12	2940	
		1.02	630	MWM-Morten-Werke Manheim AG. Turbocharged Diesel
		0.95	940	
		0.62	1440	
		0.93	840	
		0.85	1250	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 94		0.55	1250	
		0.55	1920	
		0.58	1540	
		0.52	2060	
		1.44	685	
		1.02	965	
		0.99	1290	
		1.09	960	
		1.01	1280	
		0.81	1325	
		0.75	1765	
		0.60	1820	
		0.55	2425	
		0.44	2205	
		0.41	2940	
		0.46	4410	
		0.42	5880	
		0.16	156	
		0.13	184*	
D. 95		0.95	108	Allis Chalmers Complete Power System Turbocharged
		0.23	135*	
		0.76	175	
		0.85	200*	
		0.85	200	
		0.68	250*	
		0.74	230	
		0.62	275*	
		0.24	63	Allis Chalmers Diesel Engine only Turbocharged
		0.23	70	
		0.23	95	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 95		0.16	109	
		0.24	121	
		0.27	157	
		0.30	231	
		0.24	291	
		0.22	315	
D. 96		0.55	200	Including generator using overall dimensions
		0.46	900	

* stand-by operation

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 19	100		10,000	
D. 54		13.9-15.4	1120	
D. 58		6.00	96.9	"ERDA Car"
D. 16		124	10	For power generation
		180	5	For power generation
D. 39		14.5	165	Based on Caterpillar Engine Model #D-334 using #2 Diesel Oil
D. 90		80	2000	Generator and Engine only
		48	5000	
D. 91		23.3	200	600 HZ-Stand-by Operation
		19.7	285	
		24.05	420	
		17.8	560	
		21.4	765	
		22.2	800	
		20.5	1040	
		21.6	1050	
		25.7	235	
		25.5	140	
		20.7	220	60 HZ-Stand-by Operation Basic Engine Weight vs Maximum kW rating at P.F. = 1.0
		19.7	440	
		16.2	580	
		17.7	800	
		17.1	1070	
		15.1	670	
		18.5	335	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant		Plant Size, kW	Assumptions of Advanced State of the Art
		Dry Weight			
D. 91		17.0		1100	
		17.8		825	
D. 92		Dry Weight	Other		
		20.3	21.1	2100	
		18.9	19.7	2250*	
		18.4	19.2	2310	
		17.0	17.8	2500*	
		15.9	16.6	2675	
		14.4	15.1	2950*	
		25.4	26.5	1675	
		23.6	24.7	1800	
		24.7	25.8	1720	
		22.8	23.8	1865*	
		21.3	22.2	2000	
		19.3	20.2	2200*	
		16.7	17.4	2000	
		15.2	15.8	2200*	
		26.8	27.8	1250	
		22.9	23.8	1460*	
		25.7	26.8	1300	
		22.3	23.2	1500*	
		21.2	22.1	1575	
		18.3	19.1	1825*	
		19.2	20.0	1740	
		16.5	17.2	2020	
		25.3	26.4	1320	
		22.9	23.8	1460	
		22.3	23.2	1500*	
		20.0	20.8	1675*	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant: Dry Weight	Parameter Value Operating Plant: Other	Plant Size, kW	Assumptions of Advanced State of the Art
D. 92		24.5	25.7	2050	
		23.9	25.1	2100	
		22.3	23.4	2250	
		21.4	22.4	2350	
		19.7	20.7	2550	
		17.9	18.8	2800	
		17.7	18.6	2830*	
		16.0	16.8	3135*	
		31.1	32.6	830	
		30.1	31.5	860	
		28.7	29.1	930*	
		24.9	26.0	1040	
		23.0	24.0	1125*	
		22.3	23.3	1160	
		20.7	21.6	1250*	
		28.7	31.0	800	
		27.0	29.2	850*	
		26.5	28.7	865	
		24.5	26.5	935*	
		23.0	24.8	1000	
		20.9	22.6	1100*	
		36.1	39.1	635	
		34.8	35.4	700*	
		31.6	34.2	725*	
		28.7	31.0	800	
		27.0	29.2	850*	
D. 93		42.5	44.0	2000	Marina-Electric Stationary
		35.5	36/6	2650	
		40.7	42.2	2000	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Study	Operating Plant: Dry Weight	Operating Plant: Other	Plant Size, kW	Assumptions of Advanced State of the Art
D. 93		34.1	35.2	2650	
		36.3		4300	Fairbanks Morse Engine
		28.0		5586*	Division Turbocharged Diesel
		34.9		5010	
		26.8		6517*	
		34.5		5730	
		26.6		7448*	
		33.7		6445	
		26.0		8379*	
			40.2	10700	
			39.4	12840	
			39.7	14980	
			38.6	17120	
			37.7	19260	
			25.5	140	Detroit Diesel Allison
			20.7	220	Engines-Turbocharged Stand-by Units
			19.0	290	
			18.5	335	
			19.7	440	
			16.2	580	
			15.1	670	
			17.7	800	
			17.8	825	Jacket Water Cooler
			17.1	1070	
			17.0	1100	Jacket Water Cooler
			10.0	355+	Deutz KHD Diesels,
			9.5	475+	Turbocharged with Charge Air Cooling
			9.0	710+	+ (Two Stage Combustion)
			8.4	950+	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 93		Dry Weight Other		
		17.2	1100	
D. 94		15.8	1650	
		16.3	2200	
		15.5	1170	
		15.1	1560	
		14.6	1755	
		14.4	2340	
		13.8	3120	
		11.2	3795	
		11.3	4430	
		11.0	5060	
		10.6	5695	
		25.9	2470	
		24.8	3295	
		21.4	4940	
		20.1	6590	
		81.8	625	Bombardier Inc. Turbo-charged Diesel
		64.9	780	
		52.9	1040	
		48.8	1400	
		43.4	1575	
		38.8	2100	
		35.4	2550	
		74.0	685*	
		55.7	910*	
		48.7	1130*	
		42.8	1595*	
		37.4	1825*	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 94		36.1	2260*	
		31.7	2850*	
		116.7	30	Stewart and Stevenson Does not mention turbo-charging. System for Air-line Ground Skid Mounted Units
		79.2	48	
		63.3	60	
		55.6	72	
		42.5	100	
		45.5	112	
		43.0	128	
		35.6	160	
		43.3	4860	Grand Motori Trieste Turbo-charged Diesel
		43.5	6075	
		44.4	7290	
		43.3	8505	
		42.1	9780	
		41.7	10935	
		41.0	12150	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Total Wt.	Eng. Wt.	Gen.Wt.	Plant Size, kW	Assumptions of Advanced State of the Art
D. 94	61.1	20.5	40.6	635	
	52.4	18.5	33.9	950	
	46.0	16.3	29.7	1270	
	42.2	15.8	26.4	1905	
	38.7	14.7	24.0	2540	
	92.9	32.2	60.7	515	
	85.7	30.1	55.6	630	
	81.2	28.3	52.9	770	
	73.5	26.5	47.0	1030	
	86.9	31.8	55.1	1200	
	77.1	28.7	48.4	1820	
	70.5	26.9	43.6	2425	
	67.9	25.9	42.0	2725	
	61.1	23.3	37.8	3610	
	56.3	21.8	34.5	4850	
	54.5	21.4	33.1	5455	
	Wt.Flywheel	**W/O Flywheel**			
	1.35		21.6	740	Krupp Mak Maschinen bau GMbH Turbocharged Diesel
	1.04		16.7	960	
	0.78		14.7	1290	
	1.69		23.1	590	
	1.00		14.2	1000	
	0.76		13.6	1320	
	0.50		12.0	2000	
	2.27		27.3	1320	
	1.69		26.6	1770	
	1.11		22.2	1800	
	0.83		21.7	2400	
	0.74		21.1	2700	
	0.56		20.0	3600	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant: Wt. Fly-Wheel	Parameter Value Operating Plant: W/O Flywheel	Plant Size, kW	Assumptions of Advanced State of the Art
D. 94		0.42	19.2	4800	
		2.25	28.1	3200	
		1.69	28.2	4250	
		1.00	31.0	7230	
		1.09	27.7	3680	
		0.82	27.4	4890	
		0.72	28.3	5520	
		0.54	27.7	7360	
		0.44	29.8	9000	
		0.73	38.2	5500	
		0.55	37.1	7280	
		0.49	35.2	8240	
			148.5	1.35	Kirloskar Diesels Does not mention turbo-charging. Data is presented here for model with least weight per kW. Units are either water cooled or air cooled.
			125.0	1.60	
			95.2	3.70	
			62.2	7.5	
			67.8	5.20	
			45.3	10.5	
			72.8	4.6	
			58.0	9.3	
			42.2	18.7	
			33.6	28.0	
			26.6	37.5	
			23.0	56.3	
			63.2	14.2	
			53.0	21.3	
			40.9	27.6	
			33.7	41.4	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant		Plant Size, kW	Assumptions of Advanced State of the Art
		Other			
D. 94		36.1		16.8	
		68.1			
		57.4		115.2	
		49.7		152.9	
		36.5		214.0	
		38.5		177.5	
		39.2		190.9	
		33.3		254.3	
		35.0		880	Brons Industri Turbo Diesels
		31.1		990	
		28.0		1100	
		31.9		1175	
		28.3		1325	
		25.5		1470	
		30.7		1760	
		27.1		1990	
		24.5		2200	
		29.1		2350	
		25.8		2650	
		23.2		2940	
		Synchrous Generator	Driving Motor		
D. 94		39.9	64.0	21	Pezetel. Does not mention turbocharging
		30.8	36.3	30	
		19.0	30.0	44	
		15.0	18.7	100	
		12.9	19.3	60	
		13.0	13.2	200	
		15.6	16.9	300	
			34.6	630	MWM: Morten-Werke Manheim AG. Diesel with Turbocharging

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
	Synchrous Generator	Driving Motor		
D. 94		25.0	630	
		17.2	1440	
		33.0	840	
		23.5	1250	
		16.1	1920	
		16.1	1540	
		15.0	2060	
		55.1	685	
		40.7	965	
		40.5	1290	
		59.4	960	
		55.6	1280	
		43.9	1325	
		41.2	1765	
		35.1	1820	
		32.3	2425	
		24.0	2205	
		22.5	2940	
		19.0	4410	
		18.0	5880	
		Basic Weight		
D. 94		19.1	51	John Deere
		17.4	56	
		14.7	85	
		16.5	106	
		13.9	173	
		11.8	106	
		10.8	167	
		12.0	266	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged (continued)

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant		Plant Size, kW	Assumptions of Advanced State of the Art
			Basic Weight		
D. 94			13.9	70*	
			13.7	71*	
			11.8	106*	
			13.3	132	
			11.4	210*	
			9.9	182*	
		Engine Only	Total Weight		
D. 95			49.3	75	Allis Chalmers
			37.0	100*	
			46.9	175	
			41.0	200*	
			42.5	200	
			34.0	250*	
			37.0	230	
			30.9	275*	
		12.6		63	
		11.5		70	
		11.6		95	
		9.4		109	
		11.8		121	
		14.6		157	
		14.2		231	
		11.3		291	
		10.6		315	
D. 96		28.6		200	Including generator, radiator, starting and assortment of optional attachments.
		22.9		900	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: O & M Cost (all in 1980 $)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 83		28.96 $/truck	1st year	Diesel trucks averages for 25 truck fleet
		54.70 $/truck	2nd year	
		84.83 $/truck	3rd year	
		120.92 $/truck	4th year	
D. 69	0.83 Mills/KwHr		746	Read from a curve
	0.30 Mills/KwHr		2238	
	0.16 Mills/KwHr		5968	
D. 90		1.5 mills/kWhr	2000-5000	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: Acquisition Cost ($/Kw) (In 1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 19	900		20,000	Installed cost
D. 16	637		10	
D. 16	1027		5	
D. 43	326		1500	Engine and Generator (Superior 40-X-16 model)
	1118		1500	Total Installed Cost-Co-generation Application (Superior 40-X-16 model)
D. 90		350	2000	Engine and Generator Only
		320	5000	Engine and Generator Only
D. 96		140.6	200	Include generator, radiator, starting and assortment of Optional Attachments
		137	900	

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: Lifetime (Hours of operation)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 33	9000			Between major overhauls-used for pumping high wax oil
D. 85		20,000		Between major overhauls (railroad application)
		24,000		Marine applications
D. 23		20,000-30,000		Between major overhauls (military applications)
D. 43	20,000 to 30,000			Between Major overhauls (20 yrs life) cogeneration application
D. 90		10,000		Between major overhauls expected by Detroit Diesel Allison
D. 96		15,000	200	Between major overhauls
		15,000	900	Between major overhauls

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: Operational Constraints

Constraint	Energy Conversion Systems Reference Studies	Energy Conversion Systems Reference Operating Plants
Environmental		
Thermal Discharge		
Air Pollution	D. 69	D. 58
Noise		
Solid Waste		
Chemical Waste		
Location		
Water Requirements		
Manning Requirements		
Fuel Delivery		
Solar Insolation		
Wind Requirement		
Metropolitan Siting		
Electrical Power Requirement		
Operational		
Part Load Efficiency		
Part Load Capability		
Solar, Wind Dependence		
Overload Capacity		
Load Following		
Life Dependence on Cycling		

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameter: Startup/Shutdown Time (minutes)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 57	1-3			From cold start to full load
D. 91		<0.10-0.13	200-1050	Start-up Time
		0.05-0.10	200-1050	Shutdown Time
D. 90		<10		Start-up
		5		Cool Down
D. 95		0.08-0.17		Start-up Timt
D. 96		0.17	200	Start-up Time
		0.17	900	Start-up Time
		.033	200	Shutdown Time
		.033	900	Shutdown Time

DATA SHEET

Energy Conversion System: Diesel Engine-Turbocharged

Parameters:	Energy Conversion System References: Studies	Operating Plants
Reliability	D. 26, D. 12, D. 33, D. 83, D. 69, D. 16	
Growth Potential		
Availability of Raw Materials	D. 63, D. 46	
Type		
Development		

DATA SHEET

Energy Conversion System: Diesel Engine-Adiabatic

Parameter: Lifetime, Hrs.

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
D. 53		350		Testing of prototype unit at up to 2500 PSI peak pressure

DIESEL ENERGY CONVERSION SYSTEMS

Bibliography

D-1	ACCESSION NO.	80C0063966
	REPORT NO.PAGE	CONF-791082--(SUMM PP. 523-527
	TITLE	USE OF HYBRID FUELS IN A SINGLE-CYLINDER DIESEL ENGINE
	AUTHORS	MOSES, C.A.
	TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS CONTRACTORS COORDINATION MEETING. SEVENTEENTH SUMMARY REPORT
	PAGE NO	523-527
	AVAILABILITY	NTIS, PC A99/MF A01.
	CONF TITLE	DOE AUTOMOTIVE TECHNOLOGY DEVELOPMENT CONTRACTORS COORDINATION MEETING
	CONF PLACE	DEARBORN, MI, USA
	CONF DATE	23 OCT 1979
	DATE	1979
	CATEGORIES	EDB-330600;330102
	PRIMARY CAT	EDB-330600
	REPORT NO	CONF-791082--(SUMM.)
	ABSTRACT	EXPERIMENTS CONDUCTED IN A SINGLE-CYLINDER DIESEL ENGINE WITH WATER/FUEL EMULSIONS AND ALCOHOL/FUEL BLENDS (SOLUTIONS AND EMULSIONS) ARE BRIEFLY DESCRIBED. FUELS ARE COMPARED IN TERMS OF SPECIFIC ENERGY CONSUMPTION, SPECIFIC DIESEL FUEL CONSUMPTION (A MEASURE OF PETROLEUM CONSERVATION), AND SPECIFIC COST. LIMITED ENGINE EXPERIMENTS HAVE BEEN CONDUCTED WITH CARBON AND CARBOHYDRATE SLURRIES AND SOLUBLE CARBOHYDRATES. IT IS CONCLUDED THAT COMPRESSION IGNITION ENGINES CAN BE OPERATED SATISFACTORILY ON DIESEL FUEL-DRY ETHANOL SOLUTIONS; ETHANOL-DIESEL FUEL SOLUTIONS ARE VERY WATER-SENSITIVE; THE ALCOHOL EMULSIONS ARE VIABLE DIESEL ENGINE FUELS; AND THE USE OF SLURRY FUELS APPEARS TO BE POSSIBLE.
	DESCRIPTORS	ALCOHOL FUELS;CARBOHYDRATES;CARBON;COST: 02;DIESEL ENGINES: 11; DIESEL FUELS: T2,01;ENERGY CONSUMPTION;ENERGY SUBSTITUTION EQUIVALENT;HYDROCARBONS;MIXTURES;PERFORMANCE: 02;RESEARCH PROGRAMS

D-2	ACCESSION NO.	80C0063963
	REPORT NO.PAGE	CONF-791082--(SUMM PP. 501-507
	TITLE	OVERVIEW OF THE ALTERNATIVE FUELS FOR MEDIUM-SPEED DIESEL ENGINES (AFFMSDE)
	AUTHORS	FOSTER, R.W.
	TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS CONTRACTORS COORDINATION MEETING. SEVENTEETH SUMMARY REPORT
	PAGE NO	501-507
	AVAILABILITY	NTIS, PC A99/MF A01.
	CONF TITLE	DOE AUTOMOTIVE TECHNOLOGY DEVELOPMENT CONTRACTORS COORDINATION MEETING
	CONF PLACE	DEARBORN, MI, USA
	CONF DATE	23 OCT 1979
	DATE	1979
	CATEGORIES	EDB-330600;330102
	PRIMARY CAT	EDB-330600
	REPORT NO	CONF-791082--(SUMM.)
	ABSTRACT	DIESEL ENGINES OPERATING WITH NOMINAL SPEEDS OF 300 TO 1000 RPM ARE MEDIUM SPEED ENGINES FINDING USE IN MARINE, RAILROAD, LARGE-SCALE EARTH-MOVING EQUIPMENT, POWER GENERATING STATIONS, INDUSTRIAL POWER SYSTEMS, AND ON-SHORE AND OFF-SHORE OIL DRILLING EQUIPMENT SYSTEMS. THE PROJECT MANAGEMENT PLAN IS DESCRIBED. ITS MAIN OBJECTIVE IS TO EXPLORE THE TECHNICAL, BUSINESS OPERATIONS, AND BUSINESS ECONOMICS IMPACTS THAT WOULD BE ENCOUNTERED IN THE CONVERSION FROM CONVENTIONAL, PETROLEUM-BASED FUELS TO ALTERNATIVE, NON-PETROLEUM BASED FUEL SYSTEMS. RAIL SYSTEMS ARE EMPHASIZED, BUT PROBLEMS ENCOUNTERED IN OTHER APPLICATIONS SHOULD BE GENERALLY SIMILAR. STATUS OF THE MULTI-CYLINDER ENGINE TEST FACILITY BEING CONSTRUCTED AT SOUTHWEST RESEARCH INSTITUTE IS REVIEWED.
	DESCRIPTORS	DIESEL ENGINES: T1,02;DIESEL FUELS: T3,01;DRILLING EQUIPMENT; ECONOMICS;EVALUATION;FUEL SUBSTITUTION;PERFORMANCE: 03;PLANNING; POWER PLANTS;RAILWAYS;RESEARCH PROGRAMS;REVIEWS;TRAINS: T2

D-3	ACCESSION NO.	80C0063960
	REPORT NO.PAGE	CONF-791082--(SUMM PP. 335-343

TITLE	TARADCOM ENGINE RESEARCH AND DEVELOPMENT OVERVIEW
AUTHORS	GLANCE, P.
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS CONTRACTORS COORDINATION MEETING
PAGE NO	335-343
AVAILABILITY	NTIS, PC A99/MF A01.
CONF TITLE	DOE AUTOMOTIVE TECHNOLOGY DEVELOPMENT CONTRACTORS COORDINATION MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	23 OCT 1979
DATE	1979
CATEGORIES	EDB-330102;320203
PRIMARY CAT	EDB-330102
REPORT NO	CONF-791082--(SUMM.)
ABSTRACT	DEVELOPMENT OF THE ADIABATIC DIESEL WITH GOOD POWER DENSITY AND GOOD FUEL ECONOMY FOR COMBAT VEHICLE APPLICATIONS IS DISCUSSED. THE TURBOCHARGED RECIPROCATING ENGINE WITH A SECOND STAGE TURBINE GEARED TO THE CRANKSHAFT IS LIMITED AND NEEDS NO FORCED COOLING.
DESCRIPTORS	ADIABATIC PROCESSES;COST;DESIGN;DIESEL ENGINES: T2,01;FUEL CONSUMPTION;MILITARY EQUIPMENT: T1;PERFORMANCE: 02;PROCUREMENT;RESEARCH PROGRAMS: 02;SPECIFICATIONS;WEIGHT

D-4

ACCESSION NO.	80C0083693
REPORT NO,PAGE	CONF-791082--(SUMM PP. 269-293
TITLE	OVERVIEW OF VEHICLE SYSTEMS: COMMENTS
AUTHORS	CHESNES, A.
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS CONTRACTORS COORDINATION MEETING. SEVENTEENTH SUMMARY REPORT
PAGE NO	269-293
AVAILABILITY	NTIS, PC A99/MF A01.
CONF TITLE	DOE AUTOMOTIVE TECHNOLOGY DEVELOPMENT CONTRACTORS COORDINATION MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	23 OCT 1979
DATE	1979
CATEGORIES	EDB-330600;320203
PRIMARY CAT	EDB-330600
REPORT NO	CONF-791082--(SUMM.)
ABSTRACT	THE MAIN GOAL OF THE PROGRAM IS TO PROVIDE THE LINKAGE BETWEEN ADVANCED HEAT ENGINE TECHNOLOGY DEVELOPMENT AND TECHNOLOGY USE LEADING TO ACCELERATED COMMERCIALIZATION. EIGHT PROGRAMS IN THE DOE AUTOMOTIVE TECHNOLOGY DEVELOPMENT DIVISION ARE: INTERCITY AND URBAN GAS TURBINE BUS DEMONSTRATIONS; TURBOCOMPOUND DIESEL TRUCK DEMONSTRATION; RANKINE BOTTOMING CYCLE DEVELOPMENT; CONTROLLED SPEED ACCESSORY DRIVE DEMONSTRATION; ADVANCED TRANSMISSION DEVELOPMENT; DIESEL EMISSION TECHNOLOGY; AND TECHNOLOGY ASSESSMENTS.
DESCRIPTORS	COMMERCIALIZATION;DEMONSTRATION PROGRAMS;DIESEL ENGINES;EXHAUST GASES;HEAT ENGINES;PLANNING;RANKINE CYCLE;RESEARCH PROGRAMS: 01;REVIEWS;TECHNOLOGY ASSESSMENT: 01;VEHICLES: T1

D-5

ACCESSION NO.	80R0082845
TITLE(MONO)	SIMPLE ECONOMIC EVALUATION AND APPLICATIONS EXPERIMENTS FOR PHOTOVOLTAIC SYSTEMS FOR REMOTE SITES
EDITOR OR COMP	RIOS, M., JR.
CORPORATE AUTH	SANDIA NATIONAL LABS., ALBUQUERQUE, NM (USA)
PAGE NO	47
AVAILABILITY	NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT AC04-76DP00789
DATE	1980
CATEGORIES	EDB-140600
PRIMARY CAT	EDB-140600
REPORT NO	SAND--80-0749C
ABSTRACT	A SIMPLE EVALUATION OF THE COST EFFECTIVENESS OF PHOTOVOLTAIC SYSTEMS IS PRESENTED. THE EVALUATION IS BASED ON A CALCULATION OF BREAKEVEN COSTS OF PHOTOVOLTAICS (PV) ARRAYS WITH THE LEVELIZED COSTS OF TWO ALTERNATIVE ENERGY SOURCES (1) EXTENSION OF THE UTILITY GRID AND (2) DIESEL GENERATORS. A SELECTED NUMBER OF PV APPLICATIONS EXPERIMENTS THAT ARE IN PROGRESS IN REMOTE AREAS OF THE US ARE SUMMARIZED. THESE APPLICATIONS EXPERIMENTS RANGE FROM A 23 WATT INSECT SURVEY TRAP TO A 100 KW PV SYSTEM FOR A NATIONAL PARK COMPLEX. IT IS CONCLUDED THAT PV

SYSTEMS FOR REMOTE AREAS ARE NOW COST EFFECTIVE IN REMOTE SMALL APPLICATIONS WITH COMMERCIALLY AVAILABLE TECHNOLOGY AND WILL BE COST COMPETITIVE FOR INTERMEDIATE SCALE SYSTEMS (APPROX. 10 KW) IN THE 1980S IF THE DOE 1986 COMMERCIAL READINESS GOALS ARE ACHIEVED.

DESCRIPTORS: BREAKEVEN;COMPARATIVE EVALUATIONS;COST;DEMONSTRATION PROGRAMS: U1;DIESEL ENGINES;ECONOMICS: U1;ELECTRIC GENERATORS;ELECTRIC UTILITIES;ENERGY STORAGE SYSTEMS;FUEL CONSUMPTION;PHOTOVOLTAIC POWER SUPPLIES: T1;POWER RANGE 1-10 KW;POWER RANGE 10-100 KW; POWER RANGE 10-100 W;POWER RANGE 100-1000 W;REMOTE AREAS

D-6

ACCESSION NO.: 80R0066747
TITLE(MONO): ECONOMIC AND TECHNOLOGICAL ASSESSMENT OF DIESEL ENGINES USING COAL-BASED FUELS FOR ELECTRIC POWER GENERATION. FINAL REPORT
EDITOR OR COMP: DUNLAY, J.B.; DAVIS, J.P.; MASLEN, P.L.; STEIGER, H.A.; EBERLE, M.K.
CORPORATE AUTH: THERMO ELECTRON CORP., WALTHAM, MA (USA)
PAGE NO: 233
AVAILABILITY: DEP. NTIS, PC A11/MF A01.
CONTRACT NO: CONTRACT EF-77-C-01-2647
DATE: SEP 1979
CATEGORIES: EDB-330102;014000;010405
PRIMARY CAT: EDB-330102
REPORT NO: TE--4234-37-80
ABSTRACT: THE SLOW-SPEED, TWO-STROKE DIESEL ENGINE OPERATING ON COAL-BASED FUELS IS A PROMISING POWER CONVERSION SYSTEM FOR ELECTRIC POWER GENERATING PLANTS AND FOR INDUSTRIAL COGENERATION APPLICATIONS. THE COAL-BASED DIESEL SYSTEM IS A NEAR-TERM TECHNOLOGY WHICH CAN ENCOURAGE THE USE OF COAL FUELS AND ACHIEVE SUBSTANTIAL ENERGY SAVINGS. THIS REPORT DESCRIBES: EXPERIMENTAL ENGINE PERFORMANCE DATA ON REPRESENTATIVE COAL-BASED FUELS, ECONOMICS OF TYPICAL SYSTEM INSTALLATIONS, AND DEVELOPMENT REQUIREMENTS TO MAKE THE SYSTEM COMMERCIALLY AVAILABLE. THE PROGRAM RESULTS INDICATE THAT CURRENT SLOW-SPEED, TWO-STROKE DIESEL ENGINE TECHNOLOGY CAN BE ADAPTED, WITH MINIMUM DEVELOPMENT, FOR COAL-DERIVED LIQUID FUELS IN ORDER TO ESTABLISH AN EFFICIENT POWER SYSTEM WITH MULTIFUEL CAPABILITIES AND WIDE APPLICABILITY. ENGINE TEST RESULTS ON TWO COAL-DERIVED LIQUID FUELS (COED AND SRC-II) ARE INCLUDED IN THIS REPORT. THE SLOW-SPEED, TWO-STROKE DIESEL ENGINE PERFORMS VERY WELL ON BOTH FUELS. THE RESULTS OF CONTINUING TESTS ON MICRONIZED COAL/OIL SLURRY WILL BE REPORTED IN A SEPARATE DOCUMENT. PRELIMINARY RESULTS OF THE SLURRY TESTS INDICATE THAT COAL IN THE FORM OF MICRONIZED PARTICLES IS ALSO A SATISFACTORY FUEL FOR THE SLOW-SPEED, TWO-STROKE DIESEL ENGINE IF ADEQUATE PROVISONS ARE MADE FOR FUEL INJECTION AND ASH RELATED WEAR.
DESCRIPTORS: COAL LIQUEFACTION;COAL LIQUIDS: T1,D;COED PROCESS;COST;DIESEL ENGINES: T2,D;ELECTRIC POWER;EXPERIMENTAL DATA: D;FUEL SUBSTITUTION: Q2,D;GRAPHS: D;PERFORMANCE TESTING: Q1,D;POWER GENERATION;SRC-II PROCESS;TABLES: D;TEST FACILITIES

D-7

ACCESSION NO.: 80R0066626
TITLE(MONO): DESIGN STUDY OF A TWO-PHASE TURBINE BOTTOMING CYCLE. FINAL REPORT
EDITOR OR COMP: STUDHALTER, W.R.
CORPORATE AUTH: BIPHASE ENERGY SYSTEMS, SANTA MONICA, CA (USA)
PAGE NO: 123
AVAILABILITY: NTIS, PC A06/MF A01.
CONTRACT NO: CONTRACT EY-76-C-03-1207
DATE: 15 JUN 1979
CATEGORIES: EDB-320304;425000
PRIMARY CAT: EDB-320304
AUGMENTATION: THERMINOL 66 HEATED IN DIESEL EXHAUST
REPORT NO: DOE/ET/15350--T1
ABSTRACT: THE USE OF A BIPHASE TURBINE SYSTEM TO RECOVER WASTE HEAT FROM DIESEL ENGINES WAS EXAMINED AND FOUND TO HAVE MANY FAVORABLE ATTRIBUTES. AMONG THESE WERE LOW RPM, HIGH TORQUE, LOW HEAT EXCHANGER COST, AND SIMPLICITY. SEVERAL CANDIDATE WORKING FLUID COMBINATIONS WERE TESTED AT TEMPERATURES OF INTEREST. THE CONTACT HEAT EXCHANGER CONCEPT WAS SUBSTANTIATED BY LARGE SCALE EXPERIMENT. THE PROGRAM INCLUDES SUBSCALE TESTS OF KEY HARDWARE COMPONENTS OF A BIPHASE TURBINE BOTTOMING SYSTEM. THESE ARE THE

	TWO-PHASE NOZZLE, TWO-PHASE TURBINE, AND DIRECT CONTACT HEAT EXCHANGER. A COMPREHENSIVE COST ANALYSIS WAS COMPLETED. A THREE-YEAR PROGRAM LEADING TO A FULL-SIZE SYSTEM FIELD DEMONSTRATION HAS BEEN PLANNED. PROGRESS IN THE FIRST YEAR OF THIS PROGRAM AND THE EFFORT STARTED ON THE SECOND YEAR PROGRAM ARE REPORTED.
DESCRIPTORS	BOTTOMING CYCLES: T3,U1,D;COMPATIBILITY: U2,D;COST; DEMONSTRATION PROGRAMS;DIESEL ENGINES: M1;ECONOMIC ANALYSIS: Q3,D;EXPERIMENTAL DATA: D;GRAPHS: D;HEAT EXCHANGERS;NOZZLES: D; NUMERICAL DATA: D;SPECIFICATIONS: D;STEAM TURBINES;TABLES: D; TORQUE;WASTE HEAT: U1;WORKING FLUIDS: M2,D

D-8

ACCESSION NO.	80J0066564
TITLE	ROAD TRANSPORT: BIG IS FRUGAL
AUTHORS	CUNNINGHAM, M.
PUB DESC	ENERGY MANAGER, V. 2, NO. 7, PP. 56-56
DATE	SEP 1979
CATEGORIES	EDB-320203
PRIMARY CAT	EDB-320203
ABSTRACT	THE PROSPECT OF SAVING LARGE AMOUNTS OF DIESEL FUEL, WHILE REAPING THE REWARD OF GREATER ECONOMIC EFFICIENCY IN SHIFTING BIGGER LOADS BY ROAD IS BEING INVESTIGATED IN THE UK. THE MAXIMUM WEIGHT BRITISH LORRY, THE 32-TON ARTICULATED, WITH LEGISLATIVE FUEL ECONOMY MEASURES, WOULD BE ABLE TO UTILIZE DIESEL FUEL 18% MORE EFFECTIVELY. IT IS THE WEIGHT AND SPEED OF GOODS SHIFTED AND NOT THE GROSS WEIGHT OF THE VEHICLE THAT DETERMINES THE VEHICLE'S OPERATIONAL EFFICCIENCY. WAYS IN WHICH VEHICLES CAN BE MADE MORE FUEL EFFICIENT ARE DISCUSSED.
DESCRIPTORS	COMMODITIES: T2;DIESEL ENGINES: T1;DIESEL FUELS;ENERGY EFFICIENCY;FUEL ECONOMY: U1;LAND TRANSPORT: U2;NOISE POLLUTION; REGULATIONS;TRUCKS;UNITED KINGDOM;WEIGHT

D-9

ACCESSION NO.	80R0061439
TITLE(MONO)	TRUCK NOISE IV-H: POST-FLEET TEST RESULTS ON HEAVY DUTY DIESEL TRUCKS HAVING REDUCED NOISE EMISSIONS. FINAL REPORT MAR 1977-OCT 1978
EDITOR OR COMP	HENRY, T.J.
CORPORATE AUTH	INTERNATIONAL HARVESTER CO., FORT WAYNE, IN (USA). TRUCK DIV. ENGINEERING
PAGE NO	104
AVAILABILITY	NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT DOT-OS-20222
DATE	JAN 1979
CATEGORIES	EDB-320203;330102
PRIMARY CAT	EDB-320203
REPORT NO	PB--296741
ABSTRACT	FOUR QUIETED OVER-THE-ROAD TRACTORS WERE DESIGNED AND PRODUCED. THESE WERE EVALUATED IN FLEET SERVICE. SIGNIFICANT REDUCTIONS IN DIESEL TRUCK NOISE WERE ACHIEVED WITH CURRENT STATE-OF-THE-ART BY USING A SYSTEMATIC APPROACH ON EACH MAJOR NOISE SOURCE. THE REPORT DESCRIBES THE FLEET TEST HARDWARE THAT ORIGINALLY WENT INTO SERVICE AND DOCUMENTS THE DEGRADATION AND NORMAL ABUSE OF THE NOISE CONTROL EQUIPMENT AND THE RESULTING CHANGES IN THE NOISE LEVELS AFTER THE INSERVICE LIFE OF THE LINEHAUL TRUCKS--APPROXIMATELY 3 YEARS AND 400,000 MILES. A COMPARATIVE ANALYSIS OF FLEET MAINTENANCE AND OPERATING COSTS FOR THE QUIET TRUCKS AND LIKE PRODUCTION VEHICLES IS ALSO PROVIDED.
DESCRIPTORS	COOLING SYSTEMS;DIESEL ENGINES: U1,T2;EXHAUST SYSTEMS;FUEL CONSUMPTION;MAINTENANCE: U2;MODIFICATIONS;NOISE: U1;NOISE POLLUTION;SERVICE LIFE;TRUCKS: T1

D-10

ACCESSION NO.	80R0061416
TITLE(MONO)	FEASIBILITY ANALYSIS FOR THE INTEGRATION OF AN INCINERATOR WITH WASTE HEAT RECOVERY AT THE HUD JERSEY CITY TOTAL ENERGY DEMONSTRATION SITE
CORPORATE AUTH	AMERICAN HYDROTHERM CORP., NEW YORK
PAGE NO	176
AVAILABILITY	NTIS, PC A09/MF A01.
CONTRACT NO	CONTRACT H-2155
DATE	SEP 1977

CATEGORIES EDB-320101;290600
PRIMARY CAT EDB-320101
REPORT NO PB--300041
ABSTRACT THE ECONOMIC AND ENGINEERING FEASIBILITY OF RETROFITTING AN INCINERATOR FOR COMBUSTION OF TRASH PRODUCED AT THE SUMMIT PLAZA APARTMENTS DEVELOPMENT IN JERSEY CITY, N.J., IS ANALYZED. THE SITE CHOSEN IS A TOTAL ENERGY SYSTEM DEMONSTRATION SITE, WITH A CAPABILITY FOR ACCURATE MONITORING AND DATA ANALYSIS. THE COMPLEX USES DIESEL GENERATORS FOR ELECTRICAL ENERGY, WITH THE RESULTANT WASTE HEAT BEING USED FOR DOMESTIC HEATING AND COOLING. DIESEL - FUEL - OIL - FIRED BOILERS ARE USED FOR PRODUCTION OF ADDITIONAL HEAT. A PNEUMATIC TRASH COLLECTION SYSTEM AUTOMATICALLY DEPOSITS REFUSE IN HAULING CONTAINERS. THE PROPOSED CHANGE WOULD ROUTE THE PNEUMATICALLY COLLECTED TRASH INTO A SMALL INCINERATOR WHERE IT WOULD BE BURNT FOR THE PRODUCTION OF HEAT, THUS LOWERING THE COSTS OF FUEL CONSUMPTION AND OF LABOR, AND DEMONSTRATING AN INTEGRATED SYSTEM FOR USING TRASH AS A SOURCE FOR HEAT GENERATION. COMMERCIALLY AVAILABLE INCINERATORS WITH HEAT RECOVER SYSTEMS ARE SURVEYED AND DESCRIBED. THE PROBLEMS OF CORROSION POTENTIAL, PARTICULATE DEPOSITS, AND THERMAL ENERGY STORAGE ARE CONSIDERED. THE SOLID WASTE GENERATED AT THE SITE WAS ANALYZED. ENVIRONMENTAL AND ECONOMIC GAINS AND LOSSES ARE SUMMARIZED. THE STUDY CONCLUDES THAT THE EQUIPMENT NECESSARY IS AVAILABLE; THE LOW AMOUNT OF TRASH PRODUCED AT THE SITE WOULD RESULT IN A FINANCIAL LOSS, BUT THE DATA COLLECTION FACILITIES OF THE SITE WOULD ALLOW FOR A USEFUL DEMONSTRATION. INCLUDED ARE REFERENCES, DIAGRAMS OF HEAT SYSTEMS AND INCINERATORS, DATA ON REFUSE, GRAPHS OF OPERATING COSTS AND SAVINGS, AND SPECIFICATIONS OF INCINERATOR SYSTEMS.
DESCRIPTORS AIR CONDITIONING;APARTMENT BUILDINGS: T1;DEMONSTRATION PROGRAMS; DIESEL ENGINES;ECONOMIC ANALYSIS: Q2;FEASIBILITY STUDIES: Q2; HEAT RECOVERY;INCINERATORS;MUNICIPAL WASTES;OPERATING COST; SPACE HEATING;TOTAL ENERGY SYSTEMS: Q1,T2;WASTE DISPOSAL

D-11 ACCESSION NO. 80J0059629
TITLE WINTER HINTS ON OPERATING DIESELS
AUTHORS CHIRONIS, N.P.
PUB DESC COAL AGE, V. 84, NO. 9, PP. 84-81
DATE SEP 1979
CATEGORIES EDB-012000;013000
PRIMARY CAT EDB-012000
ABSTRACT DIESEL NO. 1 FUEL IS ALREADY IN SHORT SUPPLY, AND BY THE TIME WINTER ROLLS AROUND, IT IS EXPECTED THERE WILL BE EVEN LESS. MINE OPERATORS MAY HAVE TO RELY ON DIESEL NO.2 FUEL, WHICH TENDS TO GEL AND FORM WAX CRYSTALS IN FREEZING WEATHER. THIS PRECIPITATES MAJOR WINTER PROBLEM--DIESEL START-UP. THIS ARTICLE PROVIDES A ROUNDUP OF SUCCESSFUL METHODS THAT HELP REDUCE HANDLING PROBLEMS WHEN TRANSPORTING COAL DURING FREEZING WEATHER. THESE METHODS INCLUDE THE SPRAYING OR INJECTION OF ETHER INTO THE ENGINE'S INTAKE SYSTEM, HEATING FUEL AT THE FILTER, PREHEATING INTAKE AIR, AND THE USE OF THERMATIC FANS.
DESCRIPTORS COAL MINES: T1;DIESEL ENGINES: T2;DIESEL FUELS: Q2;LOW TEMPERATURE;MINE HAULAGE: Q1;START-UP

D-12 ACCESSION NO. 80J0055325
TITLE DETERMINATION OF THE RELIABILITY OF EMERGENCY DIESEL GENERATORS
AUTHORS SOMMER, P.
AUTHOR AFF TECHNISCHER UEBERWACHUNGS-VEREIN RHEINLAND E.V., KOELN (GERMANY, F.R.). FACHBEREICH KERNTECHNIK
PUB DESC ATOMKERNENERG./KERNTECH., V. 35, NO. 1, PP. 65-66
DATE 1980
CATEGORIES EDB-200100
PRIMARY CAT EDB-200100
ABSTRACT THE RELATIONSHIP BETWEEN RUNNING TIME, FAILURE RATE, AND RELIABILITY OF EMERGENCY DIESEL GENERATORS IS DETERMINED ON THE BASIS OF ACTUAL OPERATING EXPERIENCE.
DESCRIPTORS DIESEL ENGINES: T1;DISTRIBUTION FUNCTIONS;ELECTRIC GENERATORS: T2;ELECTRIC POWER;FAILURE MODE ANALYSIS;FAILURES;OPERATION; POWER GENERATION;PROBABILITY;RELIABILITY: Q1,Q2;TIME DEPENDENCE

D-13

ACCESSION NO. 80C0053E33
TITLE(MONO) ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
EDITOR OR COMP FAIRBANKS, J.W.; STRINGER, J. (EDS.
CORPORATE AUTH DEPARTMENT OF ENERGY, WASHINGTON, DC (USA). ASSISTANT SECRETARY FOR FOSSIL ENERGY; ELECTRIC POWER RESEARCH INST., PALO ALTO, CA (USA). FOSSIL FUEL AND ADVANCED SYSTEMS DIV.
PAGE NO 976
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES
CONF PLACE CASTINE, ME, USA
CONF DATE 30 JUL 1979
DATE DEC 1979
CATEGORIES EDB-010404;010405;360100;360200;421000;200104;014000
PRIMARY CAT EDB-010404
REPORT NO CONF-790749--
ABSTRACT THE FIRST CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATIVE FUEL CAPABLE DIRECTLY FIRED HEAT ENGINES WAS HELD AT THE MAINE MARITIME ACADEMY, CASTINE, MAINE. IT WAS SPONSORED BY THE US DEPARTMENT OF ENERGY, (ASSISTANT SECRETARY FOR FOSSIL ENERGY) AND THE ELECTRIC POWER RESEARCH INSTITUTE, (DIVISION OF FOSSIL FUEL AND ADVANCED SYSTEMS). FORTY-FOUR PAPERS FROM THE PROCEEDINGS HAVE BEEN ENTERED INTO EDB AND ERA AND ONE ALSO INTO EAPA; THREE HAD BEEN ENTERED PREVIOUSLY FROM OTHER SOURCES. THE PAPERS ARE CONCERNED WITH US DOE RESEARCH PROGRAMS IN THIS AREA, COAL GASIFICATION, COAL LIQUEFACTION, GAS TURBINES, FLUIDIZED-BED COMBUSTION AND THE MATERIALS USED IN THESE PROCESSES OR EQUIPMENTS. THE MATERIALS PAPERS INVOLVE ALLOYS, CERAMICS, COATINGS, CLADDING, ETC., AND THE FABRICATION AND MATERIALS LISTING OF SUCH MATERIALS AND STUDIES INVOLVING CORROSION, EROSION, DEPOSITION, ETC. (LTN)
DESCRIPTORS ALLOYS;CERAMICS;CLADDING;COAL GASIFICATION: T1;COAL LIQUEFACTION: T2;COATINGS: T6;CORROSION;DIESEL ENGINES: T5; EROSION;FLUIDIZED-BED COMBUSTION: T4;FUEL SUBSTITUTION;GAS TURBINES: T3;HOT GAS CLEANUP;LEADING ABSTRACT;MATERIALS: Q1,Q2,Q3,Q4,Q5;MATERIALS TESTING;MECHANICAL PROPERTIES; MEETINGS: Q6,Q7;PROTECTIVE COATINGS: T7;RESEARCH PROGRAMS;US DOE

D-14

ACCESSION NO. 80R0050920
TITLE(MONO) AN INITIAL ASSESSMENT OF THE LITERATURE ON THE MEASUREMENT, CONTROL, TRANSPORT, TRANSFORMATION AND HEALTH EFFECTS OF UNREGULATED DIESEL ENGINE EMISSIONS. FINAL REPORT, MARCH 1976--JANUARY 1979
EDITOR OR COMP ANDON, J.; SIEGEL, H.M.; JOHNSON, J.H.; LEDDY, D.G.; SMALY, S.
CORPORATE AUTH SOUTH COAST TECHNOLOGY, INC., SANTA BARBARA, CA (USA)
PAGE NO 516
AVAILABILITY NTIS, PC A22/MF A01.
CONTRACT NO CONTRACT DOT-HS-7-01790
DATE JAN 1979
CATEGORIES EDB-500200;560306
PRIMARY CAT EDB-500200
REPORT NO PB--296075
ABSTRACT THIS REPORT CONSTITUTES AN INITIAL ASSESSMENT OF THE LITERATURE IN CRITICAL AREAS RELATING TO THE MEASUREMENT, CONTROL, ATMOSPHERIC PROCESSES, AND POSSIBLE HEALTH EFFECTS OF UNREGULATED DIESEL EMISSIONS. THE FOUR MAJOR TOPICS TREATED ARE: (1) MEASUREMENT AND CHARACTERIZATION OF EMISSIONS; (2) CONTROL TECHNOLOGY; (3) ATMOSPHERIC TRANSPORT, TRANSFORMATION, AND MICROBIOLOGICAL ASSAY; (4) CARCINOGENIC HEALTH ASPECTS.
DESCRIPTORS AIR POLLUTION;AIR POLLUTION CONTROL;ATMOSPHERIC CHEMISTRY: Q1; BIOASSAY;CARCINOGENS;CASCADE IMPACTORS;CHEMICAL ANALYSIS; CHEMICAL REACTIONS;DIESEL ENGINES: T3;DIESEL FUELS: T2;ELECTRON MICROSCOPY;ENVIRONMENTAL IMPACTS: Q2;EXHAUST GASES: T1,Q3;FUEL ADDITIVES;FUEL INJECTION SYSTEMS;GAS ANALYSIS;HEALTH HAZARDS; INORGANIC COMPOUNDS;METALS;MUTAGENS;ODOR;ORGANIC COMPOUNDS; ORGANIC OXYGEN COMPOUNDS;PARTICLE SIZE;PARTICLES;PHYSICAL PROPERTIES;POLYCYCLIC AROMATIC HYDROCARBONS;PUBLIC HEALTH; REGULATIONS;SAMPLING;SULFATES;URBAN AREAS

D-15

ACCESSION NO.	BOV0044615
TITLE(MONO)	DESIGN DEMANDS ON THE EMERGENCY POWER SUPPLY OF NUCLEAR POWER STATIONS
EDITOR OR COMP	SOMMER, P.
PUB DESC	AT. STROM. NO. 1/2. PP. 4-6
TRANS NOTE	A
PAGE NO	15
AVAILABILITY	DEP. NTIS (US SALES ONLY). PC A02/MF A01.
DATE	1975
CATEGORIES	EDB-220200
PRIMARY CAT	EDB-220200
REPORT NO	RTS--11691
ABSTRACT	IN VIEW OF VARIOUS PUBLICATIONS CONCERNING FAILURE RATES IN DIESEL UNITS THE RHINELAND INDUSTRIAL SUPERVISION ASSOCIATION INVESTIGATED FAILURES OF DIESEL UNITS AT A GERMAN NUCLEAR POWER STATION. OBSERVATIONS ARE PRESENTED WHICH ARE BASED ON A COMPARISON BETWEEN THE FAILURE RATES CALCULATED FROM THE ACTUAL FAILURES AND THE DATA IN THE LITERATURE.
DESCRIPTORS	COMPARATIVE EVALUATIONS;DIESEL ENGINES: T2,01;ENGINEERED SAFETY SYSTEMS;FAILURES: 02;NUCLEAR POWER PLANTS: T1;PERFORMANCE;POWER SUPPLIES;RELIABILITY: 02

D-16

ACCESSION NO.	BOR0040582
TITLE(MONO)	ARMY PROCUREMENT OF 10KW, 60HZ GAS TURBINE GENERATORS IS HIGHLY QUESTIONABLE. REPORT TO THE CONGRESS
CORPORATE AUTH	GENERAL ACCOUNTING OFFICE, WASHINGTON, DC (USA). PROCUREMENT AND SYSTEMS ACQUISITION DIV.
PAGE NO	30
AVAILABILITY	NTIS, PC A03/MF A01.
DATE	9 AUG 1979
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
REPORT NO	PB--298727
ABSTRACT	A 10-KILOWATT (KW), 60-HERTZ (HZ) GAS TURBINE GENERATOR WHICH THE ARMY PLANS TO BUY DOES NOT MEET THE ARMY'S REQUIREMENTS. ITS RELIABILITY IS TOO LOW, FUEL CONSUMPTION TOO HIGH, AND LIFE-CYCLE COST EXCESSIVE. THE ARMY COULD SAVE FROM $275 MILLION TO $1.6 BILLION OVER 20 YEARS IF IT PURCHASED DIESEL GENERATORS INSTEAD OF 5,936 10KW GAS TURBINES. GAO RECOMMENDS THAT THE ARMY (1) PURCHASE DIESEL GENERATORS INSTEAD OF GAS TURBINES FOR ITS 10KW POWER REQUIREMENTS AND (2) EVALUATE USING 5KW DIESEL AND GASOLINE GENERATORS INSTEAD OF 10KW GAS TURBINES FOR ITS 5KW POWER REQUIREMENTS.
DESCRIPTORS	DIESEL ENGINES;FUEL CONSUMPTION: 01;GAS TURBINE POWER PLANTS; LIFE-CYCLE COST: 01;MILITARY EQUIPMENT;RELIABILITY: 01; TURBOGENERATORS: T1

D-17

ACCESSION NO.	EDC0025430
REPORT NO.PAGE	CONF-7904105 PP. 310-331
TITLE	DIESEL ENGINE RESEARCH AND DEVELOPMENT STATUS
AUTHORS	ROESSLER, W.U.
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS CONTRACTORS' COORDINATION MEETING. SIXTEENTH SUMMARY REPORT
PAGE NO	310-331
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	16. HIGHWAY VEHICLE SYSTEMS CONTRACTORS COORDINATION MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	24 APR 1979
DATE	SEP 1979
CATEGORIES	EDB-330102
PRIMARY CAT	EDB-330102
REPORT NO	CONF-7904105--
ABSTRACT	A NUMBER OF AUTOMOBILE MANUFACTURERS, GOVERNMENT AGENCIES, AND OTHER ORGANIZATIONS ARE CURRENTLY INVOLVED IN A VARIETY OF IN-HOUSE AND CONTRACTED PROGRAMS IN THE AREAS OF DIESEL ENGINE TECHNOLOGY AND HEALTH EFFECTS. THE CURRENT STATUS OF THESE PROGRAMS IS DISCUSSED. (TFD)
DESCRIPTORS	AUTOMOBILES: T1;DIESEL ENGINES: T2,01;RESEARCH PROGRAMS: 02; REVIEWS

D-18

ACCESSION NO.	6CJ0034637
TITLE	MEASURING THE GAP BETWEEN THE PISTON AND CYLINDER OF AN ENGINE BY MEANS OF AN ELECTRON BEAM
AUTHORS	KARATAEV, V.D.; MACHUL'SKII, F.F.; RISKIN, I.V.; RUDENKO, V.N.; TEN, E.P.
PUB DESC	MEAS. TECH. (USSR) (ENGL. TRANSL.), V. 18, NO. 4, PP. 574-576
DATE	APR 1975
CATEGORIES	EDB-200102
PRIMARY CAT	EDB-200102
ABSTRACT	THE COMPONENT DETERMINING THE SERVICE LIFE OF MODERN BOOSTED DIESEL ENGINES IS USUALLY THE CYLINDER-PISTON ASSEMBLY. PREVIOUS METHODS FOR MEASURING GAPS BETWEEN PARTS OF THE PISTON-CYLINDER ASSEMBLY HAVE THE DRAWBACK THAT THE ENGINE PARTS HAVE TO BE SPECIALLY PREPARED IN ADVANCE, CONVERTERS (OR THEIR SENSITIVE ELEMENTS) BEING INSERTED INTO THE ZONE OF MEASUREMENT AND THE USEFUL SIGNAL FROM THESE EXTRACTED FROM THE ENGINE. A BACK-SCATTERED ELECTRON TECHNIQUE IS PROPOSED IN A SLIGHTLY MODIFIED FORM FOR MEASURING THE GAP BEHIND AN OPAQUE WALL, AND VERIFIED ON AN INTERNAL-COMBUSTION ENGINE IN MODEL FORM.
DESCRIPTORS	DIESEL ENGINES: T1;MEASURING METHODS;PISTONS;RINGS;SERVICE LIFE; WEAR: 01

D-19

ACCESSION NO. 80J0034027
TITLE DIESEL-ENGINE-DRIVEN POWER-GENERATING STATION PLANNED
PUB DESC PUBLIC UTIL. FORTN., V. 105, NO. 3, PP. 57-58
DATE 31 JAN 1980
CATEGORIES EDB-200102;425007
PRIMARY CAT EDB-200102
ABSTRACT THE SEBRING UTILITIES COMMISSION OF SEBRING, FLORIDA IS PLANNING TO CONSTRUCT A 20,000-KW POWER PLANT THAT WILL GENERATE ELECTRICITY WITH LOW-SPEED MARINE DIESEL ENGINES, EXPECTED TO BECOME OPERATIONAL IN 1982. THE DIESELS HAVE THE CAPABILITY OF BURNING THE HEAVIEST OF RESIDUAL OILS AND WILL BE ADAPTABLE TO THE USE OF COAL-DERIVED LIQUID FUEL AND POTENTIALLY A PULVERIZED COAL AND OIL SLURRY. ENERGY EFFICIENCY AND LOW-MAINTENANCE COSTS OF THE DIESELS ARE DISCUSSED.
DESCRIPTORS COAL;DIESEL ENGINES: T2,Q1;ELECTRIC UTILITIES;ENERGY EFFICIENCY: Q2;FLORIDA;FUEL SUBSTITUTION;MAINTENANCE;PETROLEUM RESIDUES;PLANNING;POWER GENERATION: T1;SLURRIES;USA

D-20

ACCESSION NO. 80R0033314
TITLE (MONO) COST/BENEFIT ANALYSIS OF A SOLAR POWER PLANT SUPPLEMENTED BY DIESEL GENERATION IN COMPARISON WITH A SOLELY DIESEL SYSTEM - OPTIMIZING FOR SIZE AND INITIAL INVESTMENT IN AN ISOLATED AREA. POSSIBILITE DE PLACEMENT ET DEMENSIONNEMENT OPTIMAL D'UNE CENTRALE ELECTROSOLAIRE A TOUR ASSOCIEE A UN DIESEL DANS UN CENTRE ISOLE
EDITOR OR COMP MANTEAU, C.
CORPORATE AUTH ELECTRICITE DE FRANCE, 78 - CHATOU. SERVICE MACHINES ET AUTOMATISMES DE PRODUCTION
PAGE NO 29
AVAILABILITY NTIS, PC A03/MF A01.
DATE APR 1977
CATEGORIES EDB-140500
PRIMARY CAT EDB-140500
REPORT NO N--79-26536
ABSTRACT ECONOMIC AND CLIMATIC CONDITIONS PERTINENT TO THE INSTALLATION OF A SOLAR POWER PLANT ARE STUDIED. THE REDUCTION OF KWH COST VIS A VIS WHOLLY DIESEL ELECTRICAL ENERGY GENERATION IS CONSIDERED. THE TRADEOFF BETWEEN INSTALLATION SIZE AND OPTIMAL OUTPUT VALUE IS DEFINED AND IDENTIFIED FOR THE TWO SYSTEMS RESPECTIVELY. THE STUDY IS HYPOTHETICAL AND IS INTENDED ONLY AS A GUIDELINE FOR FUTURE REAL MARKET SURVEYS.
DESCRIPTORS COST BENEFIT ANALYSIS: Q1,Q2;DIESEL ENGINES: T1,Q2;ELECTRIC GENERATORS;ENERGY STORAGE;INTERCONNECTED POWER SYSTEMS: T2;MATHEMATICAL MODELS;OPTIMIZATION;SIZE;SOLAR ENERGY CONVERSION;SOLAR POWER PLANTS: T1;TURBOGENERATORS

D-21

ACCESSION NO. 80R0021921
TITLE (MONO) APPLICATION FOR CERTIFICATION FOR 1976 MODEL YEAR DIESEL HEAVY-DUTY ENGINES - CATERPILLAR TRACTOR COMPANY
CORPORATE AUTH CATERPILLAR TRACTOR CO., PEORIA, IL (USA)
PAGE NO 392
AVAILABILITY ALSO AVAILABLE IN SET OF 9 REPORTS PC$265.00/MF$14.00, PB-287 050-SET.
DATE MAR 1976
CATEGORIES EDB-320203;330700
PRIMARY CAT EDB-320203
REPORT NO PB--287054
ABSTRACT EVERY YEAR EACH MANUFACTURER OF PASSENGER CARS, LIGHT-DUTY TRUCKS, MOTORCYCLES OR HEAVY-DUTY ENGINES SUBMITS TO EPA AN APPLICATION FOR CERTIFICATION. THE APPLICATION CONSISTS OF TWO PARTS. IN THE PART I, THE MANUFACTURER GIVES A DETAILED TECHNICAL DESCRIPTION OF THE VEHICLES OR ENGINES HE INTENDS TO MARKET DURING THE UPCOMING MODEL YEAR. THESE ENGINEERING DATA INCLUDE EXPLANATIONS AND/OR DRAWINGS WHICH DESCRIBE ENGINE/VEHICLE PARAMETERS SUCH AS BASIC ENGINE DESIGN, FUEL SYSTEMS, IGNITION SYSTEMS, AND EXHAUST AND EVAPORATIVE EMISSION CONTROL SYSTEMS. THE PART I ALSO PROVIDES INFORMATION ON EMISSION TEST PROCEDURES, SERVICE ACCUMULATION PROCEDURES, FUELS TO BE USED, AND PROPOSED MAINTENANCE REQUIREMENTS TO BE FOLLOWED DURING TESTING. THE PART II APPLICATION, SUBMITTED AFTER EMISSION TESTING IS COMPLETED, CONTAINS THE RESULTS OF EMISSION TESTING, A STATEMENT OF COMPLIANCE TO THE REGULATIONS,

AND MAINTENANCE INSTRUCTIONS TO BE FOLLOWED BY THE ULTIMATE OWNERS OF THE VEHICLES.

DESCRIPTORS — AIR POLLUTION CONTROL;AUTOMOBILE INDUSTRY;CERTIFICATION: Q1; DIESEL ENGINES;EXHAUST GASES;EXHAUST SYSTEMS;FUEL SYSTEMS; MAINTENANCE;POLLUTION CONTROL EQUIPMENT: Q1;REGULATIONS; VEHICLES: T1

D-22

ACCESSION NO. — 80J0020622
TITLE — ELECTROCHEMICAL ENERGY STORAGE SYSTEMS: A SMALL SCALE APPLICATION TO ISOLATED COMMUNITIES IN THE CANADIAN ARCTIC
AUTHORS — ADAMS, W.A.; GARDNER, C.L.; CASEY, E.J.
AUTHOR AFF — DEFENCE RESEARCH ESTABLISHMENT, OTTAWA, ONTARIO
PUB DESC — CAN. ELECTR. ENG. J., V. 4, NO. 3, PP. 4-10
DATE — JUL 1979
CATEGORIES — EDB-200300;250900
PRIMARY CAT — EDB-200300
ABSTRACT — THE RELATIVE FREEDOM OF THE CANADIAN ARCTIC FROM ENVIRONMENTAL EFFECTS DUE TO HUMAN ACTIVITIES AND THE PRESENCE OF MANY SMALL ISOLATED COMMUNITIES DEPENDENT ON THEIR OWN ELECTRIC POWER GENERATING SYSTEMS PROVIDES AN INTERESTING OPPORTUNITY FOR A COMPARATIVE COST/BENEFIT STUDY OF POSSIBLE ELECTROCHEMICAL ENERGY STORAGE SYSTEMS. THE HIGH COST OF FUELS IN THE ARCTIC ENCOURAGES THE DESIGN AND OPERATION OF MAXIMUM EFFICIENCY ENERGY DELIVERY SYSTEMS. THE ELIMINATION OF WASTE AT EACH STEP IS ENVIRONMENTALLY AND ECONOMICALLY DESIRABLE.
DESCRIPTORS — ARCTIC REGIONS: T1;CALCULATION METHODS;CANADA;CAPACITY: Q3,D; COMMUNITIES;COST;DATA COMPILATION: D;DIESEL ENGINES: D;DIESEL FUELS;ECONOMICS: Q2,Q3;ELECTRIC BATTERIES: T3,D;ELECTRIC UTILITIES;ENERGY CONSERVATION: D;ENERGY EFFICIENCY: D;ENERGY STORAGE: T2,Q1,Q4,D;GRAPHS: D;HUMAN POPULATIONS;LOAD MANAGEMENT; POWER SYSTEMS: T4;SERVICE LIFE: Q3,D;TABLES: D

D-23

ACCESSION NO. — 80R0009704
TITLE(MONO) — SMALL POWER SYSTEMS STUDY. VOLUME. STUDY RESULTS. TECHNICAL SUMMARY REPORT
EDITOR OR COMP — SITNEY, L.R.
CORPORATE AUTH — AEROSPACE CORP., LOS ANGELES, CA (USA). ENERGY AND RESOURCES DIV.
PAGE NO — 170
AVAILABILITY — DEP. NTIS, PC A08/MF A01.
CONTRACT NO — CONTRACT EY-76-C-03-1101-002
DATE — 31 MAY 1978
CATEGORIES — EDB-140700;200106;296000;299001
PRIMARY CAT — EDB-140700
REPORT NO — ATR--78(7693-05)-1(VOL.1)
ABSTRACT — THE DIVISION OF SOLAR TECHNOLOGY OF THE DEPARTMENT OF ENERGY IS CURRENTLY EXAMINING THE MARKET POTENTIAL OF A NUMBER OF DISPERSED SOLAR ENERGY SYSTEMS, INCLUDING THE SMALL (LESS THAN OR EQUAL TO 10 MW/SUB E/) SOLAR THERMAL POWER SYSTEM. SMALL FOSSIL-FUELED GENERATING UNITS IN THE UNITED STATES UTILITY SYSTEM, (I.E., INVESTOR-OWNED, MUNICIPAL, AND COOPERATIVES) HAVE A CURRENT CAPACITY OF APPROXIMATELY 8000 MW/SUB E/ OR ABOUT 1.5 PERCENT OF THE TOTAL US ELECTRICAL CAPACITY, AND PROVIDE A LARGE POTENTIAL MARKET FOR SMALL SOLAR THERMAL POWER SYSTEMS. THE SMALL POWER SYSTEMS STUDY HAS AS ITS OBJECTIVE THE DETERMINATION OF CONDITIONS UNDER WHICH SMALL (LESS THAN OR EQUAL TO 10 MW/SUB E/) SOLAR THERMAL POWER UNITS CAN PROVIDE COST-EFFECTIVE ELECTRICAL POWER TO A VARIETY OF USERS. POTENTIAL USERS, IN ADDITION TO THE UTILITY SYSTEMS; INCLUDE DEPARTMENT OF DEFENSE INSTALLATIONS AND APPLICATIONS, REMOTE MINING AND/OR LUMBERING OPERATIONS, AND OTHER INDUSTRIAL POWER SYSTEMS WITH AND WITHOUT COGENERATION. THE FIRST YEAR'S RESULTS ON THE SMALL POWER SYSTEMS STUDY ARE SUMMARIZED. THE DATA BASE USED AND THE BREAKEVEN COST ANALYSIS ARE DISCUSSED. INFORMATION ON BOTH SMALL (LESS THAN OR EQUAL TO 10 MW/SUB E/) GENERATING UNITS AND THE UTILITY SYSTEMS USING THEM IS PRESENTED AS WELL AS DATA ON FOSSIL FUEL COSTS, SOLAR PLANT COSTS, AND SOLAR INSOLATION VALUES. THE RESULTS OF A SURVEY OF DEPARTMENT OF DEFENSE (DOD) WORLDWIDE ELECTRICAL GENERATING CAPACITY AT ITS MILITARY BASES AND ON A POTENTIAL DOD APPLICATION ARE PRESENTED. INFORMATION ON A POTENTIAL SMALL SOLAR POWER SYSTEM EXPERIMENT IN THE INTERIOR OF ALASKA IS GIVEN, AND A LIMITED

AMOUNT OF INFORMATION ON A REMOTE APPLICATION WHICH WOULD PROVIDE POWER OR A LARGE OPEN PIT COPPER MINE IS PRESENTED. VOLUME II OF THIS TECHNICAL SUMMARY REPORT CONTAINS AN INVENTORY, BY STATE, OF THE SMALL (LESS THAN OR EQUAL TO 10 MW/SUB E/) GENERATING UNITS IN THE US UTILITY SYSTEM. (WHK)

DESCRIPTORS ALASKA;COST;DATA;DATA COMPILATION;DIESEL ENGINES;ECONOMIC ANALYSIS;ECONOMICS: Q1,Q2,Q3;ELECTRIC UTILITIES;FOSSIL-FUEL POWER PLANTS: T2;FUELS;GAS TURBINES;INSOLATION;INVENTORIES: Q2,Q3;MARKETING RESEARCH: Q1;OWNERSHIP;PERFORMANCE;POWER PLANTS: T3;POWER RANGE 1-10 MW;POWER RANGE 100-1000 KW;POWER SYSTEMS;PRICES;REMOTE AREAS;SIZE;SOLAR THERMAL POWER PLANTS: T1;STEAM TURBINES;TABLES;US DOD;USA;USES

D-24

ACCESSION NO. 80Y0005265
TITLE EFFECT OF CYLINDER CHARGE MOTION ON COMBUSTION
AUTHORS MA, T.H.
AUTHOR AFF FORD MOTOR CO., LTD., BASILDON, ENGLAND
TITLE(MONO) COMBUSTION IN ENGINES
SEC REPT NO CONF-750765--
PAGE NO 1-12
AVAILABILITY SOCIETY OF AUTOMOTIVE ENGINEERS, 400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096.
CONF TITLE CONFERENCE ON COMBUSTION IN ENGINES
CONF PLACE WARRENDALE, PA, USA
CONF DATE 7 JUL 1975
PUBL LOC INSTITUTION OF MECHANICAL ENGINEERS, LONDON, ENGLAND
DATE 1976
CATEGORIES EDB-330102;330700
PRIMARY CAT EDB-330102
ABSTRACT STUDIES ARE REPORTED OF THE EFFECTS ON COMBUSTION OF INDEPENDENT FORMS OF MOTION - ORDERLY SWIRL, PISTON INDUCED SQUISH AND SMALL SCALE TURBULENCE. FOR COMPRESSION IGNITION CYCLE ENGINES, CONSIDERATION IS GIVEN ONLY TO NATURALLY ASPIRATED DIRECT INJECTION UNITS, FOR WHICH IT IS SHOWN THAT A UNIQUE RELATIONSHIP CAN BE DETERMINED BETWEEN ORDERLY SWIRL RATES AND EXHAUST SMOKE. FOR PRE-MIXED CHARGED SPARK IGNITION ENGINES, NEITHER SWIRL NOR SQUISH IS FOUND TO BE OF DIRECT IMPORTANCE, BUT EITHER CAN AFFECT COMBUSTION BY GENERATION OF SMALL SCALE TURBULENCE. THE IMPORTANCE OF THIS IS SHOWN BY USE OF A TURBULENCE GENERATOR, DEMONSTRATING ITS EFFECT ON PERFORMANCE, THERMAL EFFICIENCY, FLAME SPEEDS AND EMISSIONS, PARTICULARLY IN RESPECT OF LEAN MIXTURES. A METHOD OF DEFINING AND MEASURING COMBUSTION QUALITY IS DISCUSSED WITH THE POSSIBLE OBJECTIVE OF USING THIS AS A GOVERNING PARAMETER IN A CLOSED LOOP ENGINE CONTROL SYSTEM.
DESCRIPTORS CLOSED-LOOP CONTROL;COMBUSTION: Q1,Q2,D;COMPRESSION;DIESEL ENGINES: T2,D;EXHAUST GASES;EXPERIMENTAL DATA: D;FLAME PROPAGATION;FUEL CONSUMPTION: D;FUEL-AIR RATIO;GRAPHS: D;INTERNAL COMBUSTION ENGINES;PERFORMANCE;PISTONS;SPARK IGNITION ENGINES: T1,D;SWIRL FLOW;THERMAL EFFICIENCY;TURBULENCE

D-25

ACCESSION NO. 79C0136097
REPORT NO,PAGE DOE/EV--0046(VOL.2 PP. 429-444
TITLE ENVIRONMENTAL CONTROL TECHNOLOGY FOR MOBILE DIESEL ENGINES
AUTHORS KEBELY, V.; FULLENWIDER, E.D.; TOMLINSON, J.C.
AUTHOR AFF THE AEROSPACE CORP., GERMANTOWN, MD
TITLE(MONO) PROCEEDINGS OF THE US DEPARTMENT OF ENERGY ENVIRONMENTAL CONTROL SYMPOSIUM. VOLUME 2. NUCLEAR ENERGY AND TRANSPORTATION
SEC REPT NO CONF-781109--(VOL.2)
PAGE NO 429-444
AVAILABILITY DEP. NTIS, PC A99/MF A01.
CONF TITLE ENVIRONMENTAL CONTROL SYMPOSIUM
CONF PLACE WASHINGTON, DC, USA
CONF DATE 28 NOV 1978
DATE SEP 1979
CATEGORIES EDB-330102;330700
PRIMARY CAT EDB-330102
REPORT NO DOE/EV--0046(VOL.2)
ABSTRACT AN ANALYSIS WAS CONDUCTED DURING MAY AND JUNE, 1978, BY THE AEROSPACE CORPORATION FOR THE DEPARTMENT OF ENERGY (DOE) DIVISION OF ENVIRONMENTAL CONTROL TECHNOLOGY TO PROVIDE AN

OVERVIEW OF DIESEL EMISSIONS CHARACTERIZATIONS, CONTROL TECHNOLOGY AND HEALTH EFFECTS. IT WAS BASED ON REVIEWS OF PUBLISHED DATA, COMPUTER SEARCHES OF RESEARCH PROJECT INVENTORIES, DISCUSSIONS WITH BOTH FEDERAL AND PRIVATE SECTOR ORGANIZATIONS, AND INFORMATION FROM THE JOINT DEPARTMENT OF TRANSPORTATION (DOT)/DEPARTMENT OF ENERGY (DOE)/ENVIRONMENTAL PROTECTION AGENCY (EPA) WORKSHOP IN WASHINGTON, DC (27 AND 28 APRIL 1978) AND THE EPA SYMPOSIUM IN ANN ARBOR, MI, (17-19 MAY 1978). AN EXECUTIVE SUMMARY OF THE STUDY FINAL REPORT IS PRESENTED WHICH: IDENTIFIES RELEVENT ISSUES; SUMMARIZES PAST AND CURRENT RESEARCH; INDICATES BROAD AREAS OF RESEARCH NEEDS; CONTAINS A BIBLIOGRAPHY OF DOCUMENTS REVIEWED, ORGANIZED BY SPONSORING AGENCIES AND PROVIDING BRIEF NOTATION ON THE OBJECTIVE AND SCOPE OF THE RESEARCH REPORTED; AND LISTS RELEVENT ONGOING RESEARCH AS EXTRACTED FROM THE FEDERAL INVENTORY OF ENERGY RELATED ENVIRONMENTAL AND SAFETY RESEARCH, AND THE SMITHSONIAN SCIENTIFIC INFORMATION EXCHANGE. THE LIST INCLUDES A SUMMARY OF THE NUMBER OF PROJECTS AND FUNDING FOR EACH RESEARCH CATEGORY.

DESCRIPTORS: AIR POLLUTION CONTROL: Q2,Q3,Q4;AUTOMOBILES;CARBON MONOXIDE: T3; DIESEL ENGINES: T1;ENVIRONMENTAL EFFECTS: Q1;EXHAUST GASES: Q1; FUEL ECONOMY;HYDROCARBONS: T2;NITROGEN OXIDES: T4;OPERATION; POLLUTION CONTROL EQUIPMENT;RESEARCH PROGRAMS

D-26

ACCESSION NO.	79J0117567
TITLE	SELECTION OF BETA PRIOR DISTRIBUTION PARAMETERS FROM COMPONENT FAILURE DATA
AUTHORS	SHULTIS, J.K.; ECKHOFF, N.D.
AUTHOR AFF	KANS STATE UNIV, MANHATTAN
PUB DESC	IEEE TRANS. POWER APPAR. SYST., V. PAS-98, NO. 2, PP. 400-407
CONTRACT NO	XX
DATE	MAR-APR 1979
CATEGORIES	EDB-220900
PRIMARY CAT	EDB-220900
ABSTRACT	PAPER NO. F78 702-3.
DESCRIPTORS	DATA ANALYSIS;DIESEL ENGINES: T2;FAILURES: Q2;NUCLEAR POWER PLANTS: T1;POWER SUPPLIES: Q1,T3;PROBABILITY;RELIABILITY: Q3

D-27

ACCESSION NO.	79J0099102
TITLE	ADVANCED TYPES OF GENERATION FOR SMALLER UTILITY SYSTEMS
AUTHORS	STEITZ, P.; MAYO, G.
AUTHOR AFF	BURNS AND MCDONNELL ENGINEERING CO., KANSAS CITY, MO
PUB DESC	PUBLIC POWER, V. 36, NO. 2, PP. 24-28
DATE	MAR 1978
CATEGORIES	EDB-200100;425000;300504
PRIMARY CAT	EDB-200100
ABSTRACT	A TECHNOLOGY ASSESSMENT AND ECONOMIC ANALYSIS ARE GIVEN ON THE USE OF SMALL MUNICIPAL AND OTHER PUBLICLY OWNED UTILITY SYSTEMS AND RURAL ELECTRIC COOPERATIVES. THE STUDY INDICATES THAT POWER SUPPLY COST REDUCTIONS CAN BE ACHIEVED BY SMALL UTILITIES IF THEY INSTALL THEIR OWN INTERMEDIATE-PEAKING RANGE CAPACITY. OF THE SEVERAL TYPES OF POWER GENERATION SYSTEMS CONSIDERED, THE FUEL CELL AND THE ORGANIC RANKINE BOTTOMING TECHNOLOGIES ARE MOST ADVANCED. (PMA)
DESCRIPTORS	BOTTOMING CYCLES;COMBINED CYCLES;COST;DIESEL ENGINES;ECONOMIC ANALYSIS;FUEL CELL POWER PLANTS;GAS TURBINES;RANKINE CYCLE POWER SYSTEMS;SIZE: Q1;STIRLING ENGINES;TECHNOLOGY ASSESSMENT: Q1;THERMAL POWER PLANTS: T1

D-28

ACCESSION NO.	79C0088386
TITLE	DESIGN OF INTEGRATED AUTOMOBILES TO MEET SOCIETAL GOALS
AUTHORS	DIGGES, D.
AUTHOR AFF	NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, WASHINGTON, DC
TITLE(MONO)	ENERGY USE MANAGEMENT
EDITOR OR COMP	FAZZOLARE, R.; SMITH, C.B. (EDS.)
SEC REPT NO	CONF-771009--P3ANDP4
PAGE NO	389-396
CONF TITLE	INTERNATIONAL CONFERENCE ON ENERGY USE MANAGEMENT
CONF PLACE	TUCSON, AZ, USA
CONF DATE	24 OCT 1977
PUBL LOC	PERGAMON PRESS INC., ELMSFORD, NY
DATE	1978
CATEGORIES	EDB-330102;291000;320203
PRIMARY CAT	EDB-330102
ABSTRACT	NHTSA'S RESEARCH SAFETY VEHICLE (RSV) PROGRAM IS DEVELOPING EXPERIMENTAL AUTOMOBILES TO MEET THE COMBINED AND BALANCED GOALS IN SAFETY, ENERGY, THE ENVIRONMENT, AND ECONOMY FOR THE 1980'S. THE VEHICLES WILL INTEGRATE AND HARMONIZE ADVANCED TECHNOLOGY IN SAFETY, FUEL ECONOMY, EMISSIONS, DAMAGEABILITY, PRODUCIBILITY, AND MAINTAINABILITY; AND THE VEHICLES WILL PROVIDE ECONOMY OF OWNERSHIP. THE PROGRAM IS BEING CONDUCTED IN 4 PHASES AND FOCUSES ON 4- AND 5-PASSENGER VEHICLES WEIGHING LESS THAN 3000 POUNDS. PHASE I, COMPLETED IN MAY 1975, INVOLVED AMF, FORD, CALSPAN, MINICARS, AND VOLKSWAGEN. PHASE II, COMPLETED IN MAY 1977, INVOLVED CALSPAN OF BUFFALO AND MINICARS OF GOLETA, CALIFORNIA. VOLKSWAGEN CONTINUED TO PARTICIPATE IN THE PHASE II PROGRAM TO ASSESS TECHNOLOGY ADVANCEMENTS THAT COULD IMPROVE THE FUEL ECONOMY AND EMISSIONS OF ENGINES SUITABLE FOR THE RSV SIZE VEHICLES. EVALUATION OF A VOLKSWAGEN TURBO-DIESEL VEHICLE IS NOW UNDERWAY. FURTHER IMPROVEMENTS IN EMISSIONS AND FUEL ECONOMY ARE ANTICIPATED DURING PHASE III. IT INCLUDES FINAL VEHICLE DESIGN AND TESTING, INTEGRATION OF IMPROVED ENGINES, AND FABRICATION OF APPROXIMATELY 17 VEHICLES

	BY CALSPAN AND MINICARS FOR INDEPENDENT EVALUATION. THIS EVALUATION WILL INCLUDE FUEL ECONOMY, EMISSIONS, AND PERFORMANCE TESTS AS WELL AS CRASH TESTS. PHASE IV WILL BEGIN IN OCTOBER 1978. IT WILL CONSIST OF INDEPENDENT TEST AND EVALUATION BY THE GOVERNMENT OF THE PHASE III VEHICLES. (MCW)
DESCRIPTORS	AUTOMOBILES: T1;DESIGN: U1;DIESEL ENGINES;ECONOMICS; ENVIRONMENTAL IMPACTS;FUEL ECONOMY: U1;MAINTENANCE;OWNERSHIP; PERFORMANCE;RESEARCH PROGRAMS;SAFETY;SOCIO-ECONOMIC FACTORS; SOCIOLOGY;SPECIFICATIONS;TECHNOLOGY UTILIZATION

D-29

ACCESSION NO.	79U0086377
REPORT NO.PAGE	CONF-7805102--(SUMM PP. 423-440
TITLE	REVIEW OF AUTOMOTIVE TECHNOLOGY STATUS AND PROJECTIONS PROJECT
AUTHORS	DOWDY, M.W.
AUTHOR AFF	JET PROPULSION LAB., PASADENA, CA
TITLE(MONO)	HIGHWAY VEHICLE SYSTEMS: CONTRACTORS COORDINATION MEETING. FOURTEENTH SUMMARY REPORT
PAGE NO	423-440
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS MEETING
CONF PLACE	TROY, MI, USA
CONF DATE	9 MAY 1978
DATE	SEP 1978
CATEGORIES	EDB-330000
PRIMARY CAT	EDB-330000
REPORT NO	CONF-7805102--(SUMM.)
ABSTRACT	THE MAJOR THRUST OF THE AUTOMOTIVE TECHNOLOGY STATUS AND PROJECTIONS PROGRAM (ATSP) IS THE ASSESSMENT OF THE POTENTIAL OF ADVANCED ALTERNATIVE HEAT ENGINE POWER SYSTEMS (BRAYTON AND STIRLING) WHEN COMPARED WITH THE EVOLVING CONVENTIONAL POWER SYSTEMS (ON OTTO, DIESEL, AND SC OTTO). FACTORS CONSIDERED IN THE STUDY INCLUDE FUEL ECONOMY, EXHAUST EMISSIONS, MULTI-FUEL CAPABILITY, USE OF ADVANCED MATERIALS, AND COST MANUFACTURABILITY. EXPERIMENTAL AND THEORETICAL DATA ON THESE FACTORS ARE PRESENTED. (LCL)
DESCRIPTORS	AAPS;AIR POLLUTION;AUTOMOBILES: T1;BRAYTON CYCLE POWER SYSTEMS: T3,01,D;COST;DIESEL ENGINES: T5,01,D;EXHAUST GASES;EXPERIMENTAL DATA: D;FEASIBILITY STUDIES;FUEL ECONOMY: 03,04,05,06,D;GRAPHS: D;HEAT ENGINES;OTTO CYCLE: T6,01,D;PERFORMANCE: D;RESEARCH PROGRAMS;STIRLING ENGINES: T4,01,D;TECHNOLOGY ASSESSMENT: 03,04,05,06;THEORETICAL DATA: D

D-30

ACCESSION NO.	79N0022037
TITLE(MONO)	ENHANCEMENT OF ON-SITE EMERGENCY DIESEL GENERATOR RELIALILITY
EDITOR OR COMP	BONER, G.L.; HANNERS, H.W.
CORPORATE AUTH	DAYTON UNIV., OH (USA). RESEARCH INST.
SEC REPT NO	UDR-TR--79-07
PAGE NO	262
AVAILABILITY	NTIS, PC A12/MF A01.
DATE	JAN 1979
CATEGORIES	EDB-220200
PRIMARY CAT	EDB-220200
REPORT NO	NUREG/CR--0660
ABSTRACT	THE UNIVERSITY OF DAYTON RESEARCH INSTITUTE HAS CONCLUDED A PROGRAM DESIGNED TO PROVIDE NRC/DOR WITH TECHNICAL ASSISTANCE IN EVALUATING THE FACTORS LEADING TO IMPROVED RELIABILITY OF ON-SITE EMERGENCY DIESEL GENERATOR (DG) UNITS. THE PROGRAM CONSISTED OF A COMPREHENSIVE REVIEW OF DG MAINTENANCE AND OPERATING EXPERIENCE AND A COMPARATIVE EVALUATION OF THE DG MANUFACTURER'S RECOMMENDATIONS. THIS INFORMATION, WILL ENABLE THE NRC TO IMPROVE THE BASIS ON WHICH IT MAKES REGULATORY DECISIONS. THE PRIMARY GOAL OF THE PROGRAM IS TO BETTER IDENTIFY THE MAIN PROBLEM AREAS WHICH DECREASE THE RELIABILITY OF THE DG UNITS AND MAKE RECOMMENDATIONS. THE REPORT HAS ATTAINED THE PROGRAM OBJECTIVES BY IDENTIFYING AND DISCUSSING THE MORE SIGNIFICANT PROBLEMS AND PRESENTING THE RECOMMENDED CORRECTIVE ACTIONS. THE IDENTIFIED PROBLEMS HAVE BEEN CATEGORIZED INTO THREE GROUPS AS A FUNCTION OF THEIR SIGNIFICANCE.
DESCRIPTORS	DIESEL ENGINES: T2,01;NUCLEAR POWER PLANTS: T1;PERFORMANCE; RELIABILITY: 02

D-31

ACCESSION NO.	79C0078263
TITLE	OPERATORS REQUIREMENTS AND OPERATIONAL EXPERIENCE WITH BATTERY ELECTRIC BUSES AND A CONSIDERATION OF FUTURE DEVELOPMENTS
AUTHORS	HELLEWELL, D.S.
TITLE(MONO)	ECONOMIC USE OF ELECTRIC ROAD VEHICLES IN A CHANGING ENVIRONMENT
SEC REPT NO	CONF-760562--
PAGE NO	14-23
CONF TITLE	INTERNATIONAL CONFERENCE ON THE ECONOMIC USE OF ELECTRIC ROAD VEHICLES IN A CHANGING ENVIRONMENT
CONF PLACE	SHEFFIELD, UK
CONF DATE	23 MAY 1976
PUBL LOC	PETER PEREGRINUS LTD., LONDON, ENGLAND
DATE	1978
CATEGORIES	EDB-330300
PRIMARY CAT	EDB-330300
ABSTRACT	A BUS OPERATORS REQUIREMENTS ARE DISCUSSED AND SOUTH YORKSHIRE PASSENGER TRANSPORT EXECUTIVE'S EXPERIENCE IN OPERATING A RANGE OF BATTERY ELECTRIC BUSES IS DESCRIBED. IN OCTOBER 1976 THE SOUTH YORKSHIRE COUNTY COUNCIL RESOLVED THAT THE GOVERNMENT SHOULD EXAMINE THE EARLY INCREASED USE OF ELECTRICITY AS A SOURCE OF MOTIVE POWER BY FURTHER RAILWAY ELECTRIFICATION AND BY DEVELOPING ELECTRICALLY POWERED PUBLIC TRANSPORT AND OTHER ROAD VEHICLES. THE DEVELOPMENT OF ALTERNATIVE ENERGY SOURCES FOR BUSES HAS BEEN OF PRIME INTEREST, AND A PROGRAM FOR TESTING A VARIETY OF PROPULSION SYSTEMS FOR BUSES COMMENCED IN 1975. INFORMATION IS PRESENTED ON: A BUS OPERATOR'S IDEAL REQUIREMENTS FOR ANY VEHICLE; THE EXPERIENCE GAINED IN SOUTH YORKSHIRE IN OPERATING BATTERY-ELECTRIC VEHICLES; OPERATOR REQUIREMENTS AND OPERATIONAL EXPERIENCE TO DATE AND PLANS FOR THE NEXT GENERATION OF BATTERY-ELECTRIC VEHICLES; AND TYPES OF STRAIGHT AND HYBRID ELECTRIC VEHICLES WHICH ARE CONSIDERED WORTHY OF FURTHER INVESTIGATION AND/OR DEVELOPMENT.
DESCRIPTORS	BUSES;COST;DESIGN;DIESEL ENGINES;ELECTRIC BATTERIES; ELECTRIC-POWERED VEHICLES: T2;ENERGY CONSUMPTION: Q2; PERFORMANCE: Q2;PERFORMANCE TESTING;POWER DEMAND;UNITED KINGDOM

D-32

ACCESSION NO.	79J0063264
TITLE	BROWN BOVERI LAUNCH -4 SERIES TURBOCHARGER
PUB DESC	DIESEL ENG., V. 74, NO. 799, PP. 233-235
DATE	WIN 1976
CATEGORIES	EDB-330102
PRIMARY CAT	EDB-330102
ABSTRACT	THE DESIGN, OPERATION, PERFORMANCE TESTING AND PERFORMANCE OF THE NEW VTR4S4 TURBOCHARGER FROM BROWN, BOVERI AND COMPANY ARE DESCRIBED. THIS TURBOCHARGER FOR DIESEL ENGINES IN THE RANGE OF FROM 4 TO 6MW OFFERS INCREASED EFFICIENCY AT PRESSURE RATIOS UP TO 4:1 AND HIGHER FUEL ECONOMY BY UTILIZATION OF EXHAUST GAS ENERGY. (LCL)
DESCRIPTORS	COMPRESSION;DESIGN;DIESEL ENGINES: T1;EFFICIENCY;EXHAUST GASES; FUEL ECONOMY;INDUSTRIAL PLANTS;OPERATION: Q2;PERFORMANCE TESTING: Q2;SHIPS;SUPERCHARGERS: T2,Q1;TRAINS

D-33

ACCESSION NO.	79J0063263
TITLE	OIL INDIA PIPELINE
PUB DESC	DIESEL ENG., V. 74, NO. 799, PP. 221-223
DATE	WIN 1976
CATEGORIES	EDB-330102;022000
PRIMARY CAT	EDB-330102
ABSTRACT	THE PUMPING STATIONS IN THE 1150 KM/LONG OIL INDIA PIPELINE WHICH IS DESIGNED TO PUMP 2.79 M TON/YR OF CRUDE OIL TO TWO REFINERIES ARE DESCRIBED. THESE PUMPING STATIONS HAVE DIESEL ENGINES WHICH ARE FUELED WITH EITHER CRUDE OIL OR CRUDE OIL AND NATURAL GAS. THE ENGINE MODIFICATIONS REQUIRED FOR CRUDE OIL BURNING, THE PERFORMANCE AND MAINTENANCE OF THE EQUIPMENT SINCE THE INITIAL INSTALLATION IN 1962, AND THE ENERGY SAVINGS ACHIEVED BY NOT USING REFINED OIL ARE DISCUSSED. (LCL)
DESCRIPTORS	DIESEL ENGINES: T4;ENERGY CONSERVATION;HYDRAULIC TRANSPORT: Q1; INDIA;MAINTENANCE: Q4;NATURAL GAS;OPERATION;PERFORMANCE: Q4; PETROLEUM: T1;PIPELINES: T2;PUMPS: Q2

D-34	ACCESSION NO.	79Y0049104
	TITLE	ENGINES AND ENERGY: FUTURE TRENDS
	AUTHORS	AGNEW. W.G.
	AUTHOR AFF	GENERAL MOTORS RESEARCH LAB.. WARREN. MI
	TITLE(MONO)	PROCEEDINGS OF A SYMPOSIUM ON IMPLICATIONS OF ENERGY CONSERVATION AND SUPPLY ALTERNATIVES
	SEC REPT NO	CONF-760150--
	PAGE NO	171-210
	CONF TITLE	SYMPOSIUM ON IMPLICATIONS OF ENERGY CONSERVATION AND SUPPLY ALTERNATIVES
	CONF PLACE	COLORADO SPRING. CO. USA
	CONF DATE	30 JAN 1976
	PUBL LOC	SCIENCE APPLICATIONS. INC.. EAST BRUNSWICK. NJ
	DATE	1978
	CATEGORIES	EDB-296000;330100
	PRIMARY CAT	EDB-296000
	ABSTRACT	DR. AGNEW POINTS OUT THAT IN THE NEAR-TERM (TO ABOUT 1990). NEW ENERGY SOURCES SUCH AS SYNTHETIC FUELS CANNOT MAKE SUBSTANTIAL CONTRIBUTIONS. IN THE LONG TERM (2000 AND BEYOND). WHEN PETROLEUM RESOURCES WILL BE SHORT. WE WILL HAVE TO CONVERT TO SYNTHETIC FUELS DERIVED FROM TAR SANDS. SHALES. OR COAL. THE TRANSPORTATION SECTOR CONSUMES 26% OF ALL U.S. ENERGY AND 55% OF THE PETROLEUM SUPPLY. THE AUTOMOTIVE INDUSTRY IS CONDUCTING POWER-PLANT R AND D PROGRAMS INVOLVING NEAR-TERM MODIFICATIONS TO THE CONVENTIONAL SPARK-IGNITION GASOLINE ENGINE. AS WELL AS RESEARCH ON ALTERNATES TO THE CONVENTIONAL SPARK-IGNITION ENGINE FOR THE LONG-TERM SITUATION. DR. AGNEW SEES IMPROVED CONVENTIONAL ENGINES. LIGHT-DUTY DIESEL ENGINES. AND STRATIFIED-CHARGE ENGINES AS FEASIBLE IN 1976 TO 1985; GAS-TURBINE ENGINES. ELECTRIC BATTERY-POWERED VEHICLES. AND METHANOL-FUELED ENGINES FOR 1985 TO 2000; AND HYDROGEN-FUELED ENGINES AND FUEL CELLS FOR 2000 AND BEYOND. EACH SYSTEM IS BRIEFLY DISCUSSED. A LENGTHY ROUNDTABLE DISCUSSION FOLLOWED. (ACW)
	DESCRIPTORS	AUTOMOTIVE FUELS;COMPARATIVE EVALUATIONS;DIESEL ENGINES; ECONOMICS;ELECTRIC-POWERED VEHICLES;ENERGY;ENGINES: T4.05; FEASIBILITY STUDIES;FORECASTING: Q4;FUEL CELLS;GAS TURBINES: T2; HYDROGEN;INTERNAL COMBUSTION ENGINES: T1;METHANOL;REVIEWS; STRATIFIED CHARGE ENGINES: T3;SYNTHETIC FUELS;TECHNOLOGY ASSESSMENT: Q1.Q2.Q3;TECHNOLOGY UTILIZATION;VEHICLES: T5
D-35	ACCESSION NO.	79C0037240
	TITLE	SINTERED SILICON NITRIDE
	AUTHORS	GAZZA. G.E.
	AUTHOR AFF	ARMY MATERIALS AND MECHANICS RESEARCH CENTER. WATERTOWN. MA
	TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II
	EDITOR OR COMP	BURKE. J.J.; LENOE. E.N.; KATZ. R.N. (EDS.)
	SEC REPT NO	CONF-770380--
	PAGE NO	1001-1010
	CONF TITLE	5. ARMY MATERIALS TECHNOLOGY CONFERENCE
	CONF PLACE	NEWPORT. RI. USA
	CONF DATE	21 MAR 1977
	PUBL LOC	BROOK HILL PUBLISHING CO.. CHESTNUT HILL. MA
	DATE	1978
	CATEGORIES	EDB-330103;360200
	PRIMARY CAT	EDB-330103
	ABSTRACT	STUDIES IN THE SINTERING OF SILICON NITRIDE ARE REVIEWED. VARIOUS APPROACHES FOR ENHANCING SINTERABILITY OF CERAMICS ARE DISCUSSED WITH REFERENCE TO CURRENT SILICON NITRIDE MATERIAL AND PROCESSING TECHNOLOGY. EXPERIMENTAL PARAMETERS USED FOR SINTERING AND PRELIMINARY DATA ON PHYSICAL AND MECHANICAL PROPERTIES OF RESULTANT PRODUCTS ARE CITED.
	DESCRIPTORS	ADDITIVES;DIESEL ENGINES;GAS TURBINES;HEAT ENGINES: T2;HIGH TEMPERATURE;MATERIALS: Q2;MECHANICAL PROPERTIES;PHYSICAL PROPERTIES: Q1;SILICON NITRIDES: T1;SINTERING: Q1;STIRLING ENGINES;USES: Q1
D-36	ACCESSION NO.	79C0037200
	TITLE	PERFORMANCE OF CERAMICS IN THE DIESEL ENGINE
	AUTHORS	GODFREY. D.J.
	AUTHOR AFF	ADMIRALTY MATERIALS LAB.. POOLE. ENGLAND
	TITLE(MONO)	CERAMICS FOR HIGH PERFORMANCE APPLICATIONS. II

EDITOR OR COMP BURKE, J.J.; LENOE, E.M.; KATZ, R.N. (EDS.)
SEC REPT NO CONF-770380--
PAGE NO 877-892
CONF TITLE 5. ARMY MATERIALS TECHNOLOGY CONFERENCE
CONF PLACE NEWPORT, RI, USA
CONF DATE 21 MAR 1977
PUBL LOC BROOK HILL PUBLISHING CO., CHESTNUT HILL, MA
DATE 1978
CATEGORIES EDB-330102;360200
PRIMARY CAT EDB-330102
ABSTRACT POTENTIAL BENEFITS ACCRUED FROM CERAMIC APPLICATIONS TO THE DIESEL ENGINE ARE BRIEFLY REVIEWED. EXPERIMENTS WITH CERAMIC PISTONS IN MODERATELY AND HIGHLY RATED ENGINES AS WELL AS EXPERIENCES WITH CERAMIC COMBUSTION CHAMBER INSERTS ARE DESCRIBED. BASED ON THESE INVESTIGATIONS THE BENEFITS IN TERMS OF EFFICIENCY APPEAR TO BE MODEST. HOWEVER PROSPECTS OF IMPROVED COMPONENT THERMAL RESISTANCE, REDUCTION OF COOLING SYSTEM SIZE, COSTS, NOISE, EMISSIONS AND WARM-UP TIME APPEAR TO BE VERY ATTRACTIVE. RIG TESTS OF A CERAMIC TURBOCHARGER ROTOR APPEAR VERY ENCOURAGING AND PROMISE SIGNIFICANT PERFORMANCE IMPROVEMENTS.
DESCRIPTORS COMBUSTION CHAMBERS: T3,Q1;DIESEL ENGINES: T1;FABRICATION; FEASIBILITY STUDIES;FUEL CONSUMPTION;MATERIALS: Q2,Q3; PERFORMANCE TESTING: Q1;PISTONS: T2,Q1;SILICON NITRIDES: T4; THERMAL STRESSES;USES: Q4

D-37 ACCESSION NO. 79R0037195
TITLE(MONO) DIESEL ORGANIC RANKINE CYCLE COMPOUND ENGINE (BOTTOMING CYCLE) PROGRAM. PROGRAM PLAN
CORPORATE AUTH DEPARTMENT OF ENERGY, WASHINGTON, DC (USA). DIV. OF TRANSPORTATION ENERGY CONSERVATION
PAGE NO 41
AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT EY-76-C-02-2832
DATE NOV 1978
CATEGORIES EDB-330102;330202
PRIMARY CAT EDB-330102
REPORT NO DOE/CS--0052
ABSTRACT A PROGRAM PLAN IS PRESENTED FOR IMPLEMENTATION OF A SINGLE VEHICLE TEST DURING FISCAL YEAR 1979 IN WHICH THE DIESEL ORGANIC RANKINE CYCLE COMPOUND ENGINE INSTALLED IN A LONG-HAUL TRUCK WILL BE TESTED AND EVALUATED AS A PRECURSOR TO FUTURE MINIFLEET DEMONSTRATION, THE ULTIMATE AIM OF WHICH IS THE IMPROVEMENT OF FUEL ECONOMY IN THIS CLASS OF TRUCK. THE SINGLE VEHICLE TEST CONSISTS OF TWO MAJOR INTERTWINED PHASES: THE FIRST CONSISTS OF INSTRUMENTATION AND CONTROLS CHECKOUT FOLLOWED BY CHASSIS DYNAMOMETER TESTS OF THE SYSTEMS AND ROAD CHECKOUT TESTS. THIS IS THEN FOLLOWED BY A SERIES OF TESTS CONDUCTED BY MACK TRUCKS AT THEIR FACILITY DURING WHICH ALL PERTINENT CHARACTERISTICS OF THE SYSTEM WILL BE ASCERTAINED.
DESCRIPTORS BOTTOMING CYCLES: Q2,Q3;DIESEL ENGINES: T2,Q1;FUEL ECONOMY;HEAT RECOVERY EQUIPMENT;PERFORMANCE TESTING;PLANNING;PROPULSION; RANKINE CYCLE ENGINES: T3,Q1;RESEARCH PROGRAMS: Q2,Q3;TRUCKS: T1;WASTE HEAT UTILIZATION

D-38 ACCESSION NO. 79C0030753
REPORT NO,PAGE EPRI-EM--718-W PP. 181-191
TITLE EXPERIENCES WITH COGENERATION
AUTHORS FOSTER-PEGG, R.W.
AUTHOR AFF WESTINGHOUSE ELECTRIC CORP., PHILADELPHIA, PA
TITLE(MONO) WORKSHOP PROCEEDINGS: DUAL ENERGY USE SYSTEMS
EDITOR OR COMP DOUGHERTY, D.A. (ED.)
SEC REPT NO CONF-7709152--
PAGE NO 181-191
CONF TITLE WORKSHOP ON DUAL ENERGY USE SYSTEMS
CONF PLACE YARMOUTH, ME, USA
CONF DATE 19 SEP 1977
DATE MAY 1978
CATEGORIES EDB-290800;320603;320303
PRIMARY CAT EDB-290800
AUGMENTATION INSTITUTIONAL PROBLEM; FAVORABLE AND UNFAVORABLE FACTORS
REPORT NO EPRI-EM--718-W

ABSTRACT THE EXPERIENCES FROM 20 SERIOUS NEGOTIATIONS FOR COGENERATION (9 WERE IMPLEMENTED) ARE DISCUSSED IN THIS PAPER. THE MAJOR PROBLEMS TO BE OVERCOME WERE PRIMARILY INSTITUTIONAL; ENGINEERING PROBLEMS WERE MINIMAL. THE SEQUENCE OF A TYPICAL NEGOTIATION BETWEEN A PROCESS COMPANY WISHING TO INSTALL COGENERATION AND A UTILITY IS ILLUSTRATED. FACTORS FAVORABLE AND UNFAVORABLE TO COGENERATION ARE PRESENTED, AND THE ADVANTAGES OF COMBUSTION TURBINES AND DIESEL ENGINES FOR COGENERATION RELATIVE TO STEAM PLANTS ARE PRESENTED.

DESCRIPTORS AVAILABILITY;CAPITAL;CO-GENERATION: M1;DIESEL ENGINES;ELECTRIC UTILITIES;ENGINEERING;FEASIBILITY STUDIES: U1;FUELS;INDUSTRIAL PLANTS;LEGAL ASPECTS;OPERATION;REGULATIONS;THERMAL EFFICIENCY; TURBINES

D-39 ACCESSION NO. 79C0021405
REPORT NO.PAGE EPA--600/7-77-073E PP. 119-141
TITLE EMISSION CHARACTERISTICS OF SMALL STATIONARY DIESEL ENGINES
AUTHORS WASSER, J.H.; STAINICK, R.M.
AUTHOR AFF ENVIRONMENTAL PROTECTION AGENCY, RESEARCH TRIANGLE PARK, NC
TITLE(MONO) PROCEEDINGS OF THE SECOND STATIONARY SOURCE COMBUSTION SYMPOSIUM. VOLUME V
EDITOR OR COMP BOWEN, J.S.; HALL, R.E.
SEC REPT NO CONF-770865--P5
PAGE NO 119-141
CONF TITLE 2. SYMPOSIUM ON STATIONARY SOURCE COMBUSTION
CONF PLACE NEW ORLEANS, LA, USA
CONF DATE 29 AUG 1977
DATE JUL 1977
CATEGORIES EDB-424000
PRIMARY CAT EDB-424000
REPORT NO EPA--600/7-77-073E
ABSTRACT INVESTIGATIONS OF EMISSIONS FROM STATIONARY RECIPROCATING INTERNAL COMBUSTION ENGINES ARE DESCRIBED. THE INITIAL PHASE OF THE IN-HOUSE RESEARCH PROGRAM IS DESCRIBED. THE WORK WAS DIRECTED AT INCREASING UNDERSTANDING OF AIR POLLUTANT EMISSIONS FROM SMALL STATIONARY DIESEL ENGINES AND INVOLVED EVALUATION OF THE USE OF EMULSIFIED FUEL AND A CATALYTIC REACTOR AS EMISSION CONTROL METHODS. A SERIES OF EXPERIMENTS WAS DESIGNED TO EVALUATE THE EMISSIONS FROM A SMALL DIESEL ENGINE, THE EFFECTS OF EMULSIFIED FUEL ON THESE EMISSIONS, AND THE EMISSION CHARACTERISTICS OF A CATALYTIC REACTOR INCORPORATED IN THE ENGINE EXHAUST SYSTEM. ALL EXPERIMENTS WERE RUN IN RANDOM ORDER AND DAILY BASELINES WERE DETERMINED TO ELIMINATE ATMOSPHERIC CONDITION EFFECTS ON EMISSION LEVELS. RESULTS WITH THE CATERPILLAR 3304 ENGINE SHOW THAT THE MAJOR AIR POLLUTION PROBLEMS FOR SMALL DIESEL ENGINES ARE THE NO/SUB X/, CO, AND FINE PARTICULATE EMISSIONS. THE PRECOMBUSTION CHAMBER DESIGN WAS EFFECTIVE IN CONTROLLING THERMAL NO/SUB X/ EMISSIONS ABOVE THE 40 KW LOAD POINT. WATER-FUEL EMULSIFICATION HAD A MIXED EFFECT ON THE EMISSIONS: NO/SUB X/ WAS DRAMATICALLY REDUCED (UP TO 60 PERCENT), BUT CO EMISSIONS WERE INCREASED BY FACTORS OF 2 TO 5. FURTHER STUDY OF EFFECTS ON PARTICULATES AND FUEL CONSUMPTION IS NEEDED. THE CATALYTIC CONVERTER REDUCED CO EMISSIONS BY OVER 90 PERCENT AND HYDROCARBONS BY OVER 60 PERCENT. THE ADVERSE EFFECTS OF THE CONVERTER INCLUDED A 15 TO 20 PERCENT INCREASE IN NO/SUB X/ AND THE CREATION OF A SIGNIFICANT SULFATE EMISSION THAT WAS NOT PRESENT IN THE UNMODIFIED ENGINE. (LCL)
DESCRIPTORS ACOUSTICS;AIR POLLUTION CONTROL: U5,U6,U7;CARBON MONOXIDE: T7; CATALYTIC CONVERTERS: T4,U2;COMBUSTION PRODUCTS;DIESEL ENGINES: T2,U1;EMULSIONS;EXHAUST GASES: U2;GASEOUS WASTES;HYDROCARBONS: T6;INDUSTRIAL PLANTS: T1;NITROGEN OXIDES: T5;OPERATION; PARTICLES;PERFORMANCE TESTING: U4;POLLUTION CONTROL EQUIPMENT

D-40 ACCESSION NO. 79C0019462
TITLE DIESEL ENGINE FOR NUCLEAR STANDBY POWER
AUTHORS FALTER, H.
AUTHOR AFF MORRISON-KNUDSEN CO., INC., ROCKY MOUNT, NC
TITLE(MONO) PROCEEDINGS OF 1975 IEEE SOUTHEASTCON REGION 3 CONFERENCE. VOLUME II. ELECTRICITY: AN EXPANDING TECHNOLOGY
SEC REPT NO CONF-750405--P2
PAGE NO 5A.3.1-5A.3.6

CONF TITLE	IEEE SOUTHEASTCON
CONF PLACE	CHARLOTTE, NC, USA
CONF DATE	7 APR 1975
PUBL LOC	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC., NEW YORK
DATE	1975
CATEGORIES	EDB-220200
PRIMARY CAT	EDB-220200
ABSTRACT	DIESEL GENERATORS ARE WIDELY USED NOT ONLY FOR PRIMARY POWER BUT ALSO FOR STANDBY OR EMERGENCY POWER SOURCES. WHEN PROPERLY MAINTAINED, DIESEL GENERATORS HAVE PROVEN TO BE HIGHLY RELIABLE AND ARE ALSO CAPABLE OF FAST STARTING AND LOAD CARRYING ABILITY. THEREFORE, AS THE NEED FOR EMERGENCY STANDBY POWER IN NUCLEAR POWER STATIONS DEVELOPED, DIESEL GENERATORS WERE CONSIDERED TO BE THE BEST SOLUTION.
DESCRIPTORS	DIESEL ENGINES: 12;ELECTRIC GENERATORS;NUCLEAR POWER PLANTS: T1; POWER SUPPLIES: 01;RELIABILITY: 02

D-41

ACCESSION NO.	79R0012393
TITLE(MONO)	CONVENTIONAL ALTERNATING-CURRENT GENERATORS AND ENGINE GENERATOR SETS
EDITOR OR COMP	SEGASER, C.L.
CORPORATE AUTH	ARGONNE NATIONAL LAB., IL (USA); OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO	61
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
DATE	APR 1976
CATEGORIES	EDB-320600
PRIMARY CAT	EDB-320600
REPORT NO	ANL/CES/TE--78-1
ABSTRACT	AVAILABLE DATA AND TECHNIQUES RELEVANT TO THE SELECTION AND ANALYSIS OF APPROPRIATE ELECTRICAL GENERATING EQUIPMENT FOR APPLICATION IN THE ICES PROGRAM ARE PRESENTED. OF THE GENERAL CLASSES OF COMMERCIALLY AVAILABLE A-C GENERATORS, THE SYNCHRONOUS, ROTATING FIELD ALTERNATOR IS MOST SUITED TO ICES APPLICATIONS, AND THE FOCUS OF THIS TECHNOLOGY EVALUATION. CONVENTIONAL 60-HZ, ALTERNATING-CURRENT GENERATORS, WITH STANDARD RATINGS RANGING FROM 1.25 KVA TO 10,000 KVA AT VOLTAGES FROM 125 SINGLE-PHASE TO 14,400 VOLTS THREE-PHASE AND SPEEDS UP TO 1800 RPM ARE COVERED. TECHNICAL DATA FOR REPRESENTATIVE DIESEL ENGINE-GENERATOR SETS FOR CONTINUOUS PRIME POWER RATINGS UP TO 6445 KW ARE PRESENTED. APPROXIMATE 1976 COSTS OF STANDARD ELECTRICAL GENERATING EQUIPMENT ARE GIVEN FOR: (1) STANDARD CONVENTIONAL ALTERNATING CURRENT GENERATORS AND (2) PACKAGED ENGINE-GENERATOR SETS. THE DATA INDICATE A DECREASE IN UNIT COSTS AS THE POWER RATINGS INCREASE, WITH THE COST OF THE SLOW-SPEED UNITS SOMEWHAT GREATER THAN THAT OF THE HIGHER SPEED UNITS. MAINTENANCE DATA FOR A TYPICAL TOTAL ENERGY PLANT PRESENTLY IN OPERATION INDICATE THAT THE AVERAGE COST OF MAINTENANCE AMOUNTS TO 41 CENTS/KWH. A PLOT OF AVAILABLE DATA ALSO INDICATES A TREND TO DECREASING OPERATING COSTS WITH INCREASING UNIT SIZE.
DESCRIPTORS	ALTERNATING CURRENT;COST;DIESEL ENGINES;ELECTRIC GENERATORS: T2,01;FUEL CONSUMPTION;ICES: T1;MAINTENANCE;PERFORMANCE: 02; RELIABILITY;SPECIFICATIONS

D-42

ACCESSION NO.	79X0012345
TITLE(MONO)	LOCOMOTIVE DATA ACQUISITION PACKAGE. PHASE I, FINAL REPORT, OCTOBER 1977--JULY 1978
EDITOR OR COMP	KIRSTEN, F.A.; ABBOTT, R.K.; MULLEN, D.R.; TURNER, D.B.
CORPORATE AUTH	CALIFORNIA UNIV., BERKELEY (USA). LAWRENCE BERKELEY LAB.
PAGE NO	122
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-48
DATE	SEP 1978
CATEGORIES	EDB-320202;330102
PRIMARY CAT	EDB-320202
REPORT NO	LBL--7945
ABSTRACT	A PRELIMINARY EXAMINATION OF THE PROBLEMS ASSOCIATED WITH RAILROAD LOCOMOTIVE DATA ACQUISITION IS PRESENTED. AN APPROACH TOWARD THE DESIGN OF A MICROPROCESSOR-BASED LOCOMOTIVE DATA

	RECORDER IS ALSO PRESENTED. SPECIAL ATTENTION IS PLACED ON DETERMINING THE FUNCTIONAL CHARACTERISTICS AND ENVIRONMENTAL SPECIFICATIONS REQUIRED FOR THE SYSTEM. THE SYSTEM DESCRIBED CONSISTS OF A MAGNETIC TAPE DIGITAL DATA RECORDER, AN ENSEMBLE OF TRANSDUCERS, AND ANALYSIS SOFTWARE. THE SYSTEM DESCRIBED IS TO BE USED AS A RESEARCH TOOL.
DESCRIPTORS	COMPUTERS;DATA ACQUISITION SYSTEMS: Q1,Q2,Q3;DESIGN;DIESEL ENGINES: T2;LIFE-CYCLE COST: Q2;MAINTENANCE;MEASURING INSTRUMENTS;PERFORMANCE;RAILWAYS: T1;RELIABILITY;RESEARCH PROGRAMS;TRAINS: T3

D-43

ACCESSION NO.	79R0012189
TITLE(MONO)	GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM. PRELIMINARY REPORT, PHASE II, AUGUST 9--NOVEMBER 6, 1977
CORPORATE AUTH	CLARK UNIV., WORCESTER, MA (USA)
PAGE NO	141
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EC-77-C-02-4211
DATE	1977
CATEGORIES	EDB-290600;291000;320600
PRIMARY CAT	EDB-290600
AUGMENTATION	CLARK UNIV., WORCESTER
REPORT NO	COO--4211-2
ABSTRACT	CLARK UNIVERSITY IN THE NEW ENGLAND AREA REPRESENTS AN ATTRACTIVE SITE FOR DEMONSTRATION OF COGENERATION. IN PHASE I OF THE PROGRAM, THE TEAM REPORTED: THAT THE SYSTEM OF CHOICE IS A DIESEL GENERATOR SIZED AT ABOUT CLARK'S PEAK ELECTRIC DEMAND; IT SHOULD BURN NO. 6 FUEL OIL; THE SYSTEM CAN RUN AT NEARLY FULL CAPACITY THE YEAR ROUND, SELL 40 PERCENT OF ITS OUTPUT, AND RECEIVE BACKUP AS NEEDED FROM MASSACHUSETTS ELECTRIC COMPANY; THE SYSTEM SHOULD DELIVER A RATE OF RETURN OF 15 TO 20 PERCENT; AND THERE APPEAR TO BE NO INSTITUTIONAL OR ENVIRONMENTAL PROBLEMS. AN UPDATE ON A NUMBER OF ISSUES THAT WERE INCOMPLETELY RESOLVED IN THE PHASE I REPORT IS PROVIDED. IN SECTION 2 ADDITIONAL DOCUMENTATION ON INSTITUTIONAL ISSUES INVOLVED IN THE PROPOSED DEMONSTRATION PLANT IS PROVIDED. IN SECTION 3 A PRELIMINARY DESIGN ANALYSIS THAT CLEARLY DEFINES THE CHOICE OF ENGINE AND PROVIDES REVISED OPERATING DATA IN LIGHT OF ADDITIONAL LOAD PROFILE STUDIES IS PROVIDED. IN PARTICULAR, IT IS FOUND THAT: A SULZER NO. 6-OIL-BURNING 1405-KW DIESEL IS THE SYSTEM OF CHOICE; THE ENGINE SHOULD BE HOUSED IN A SEPARATE BUILDING IN CLOSE PROXIMITY TO THE EXISTING CENTRAL BOILER AND STEAM DISTRIBUTION POINTS; AND AS A RESULT OF DETAILED SUMMER LOAD STUDIES, THE ENGINE AS SPECIFIED CAN BE OPERATED WITH HIGHER CAPACITY FACTORS THAN ANTICIPATED IN PHASE I. IN SECTION 4 A REVISED COST ESTIMATE USING INFORMATION DEVELOPED IN SECTIONS 2 AND 3 IS GIVEN. NO SIGNIFICANT CHANGE IN NET CASH FLOW WAS FOUND, AND THERE WAS AN INTERNAL RATE OF RETURN OF 15 PERCENT. THE OVERALL CONCLUSION IS THEREFORE THAT, THOUGH SOME DETAILS HAVE CHANGED, THE CLARK DEMONSTRATION PROJECT CONTINUES TO APPEAR HIGHLY ATTRACTIVE. (MCW)
DESCRIPTORS	CO-GENERATION;COST;DEMONSTRATION PLANTS;DIESEL ENGINES;ENERGY CONSERVATION;ENVIRONMENTAL IMPACTS;FEASIBILITY STUDIES: Q1; FINANCING;FORECASTING;FUEL OILS;HEATING OILS;ICES: T1,Q2; MASSACHUSETTS: M2;PLANNING: Q1;SYSTEMS ANALYSIS;US ERDA

D-44

ACCESSION NO.	79J0011763
TITLE	EXPERIENCE WITH SECURE ELECTRICAL POWER SUPPLIES IN SWEDEN
AUTHORS	REISCH, F.; APPELQVIST, I.
AUTHOR AFF	SWEDEN NUCLEAR POWER INSPECTORATE, STOCKHOLM
PUB DESC	NUCL. ENG. INT., V. 23, NO. 271, PP. 47-51
DATE	MAY 1978
CATEGORIES	EDB-220200
PRIMARY CAT	EDB-220200
ABSTRACT	SOME OF THE EXPERIENCE AND THE DEVELOPMENT OF THE ON-SITE POWER SUPPLIES AT SOME SWEDISH NUCLEAR POWER PLANTS IS DESCRIBED. THE PRESENT STATE OF THE ART IN SWEDEN IS DIS-CUSSED WITH REFERENCE TO SOME SPECIFIC TESTS AND TO A STATISTICAL STUDY OF THE AVAILABILITY OF DIESEL GENERATORS AND GAS TURBINES IN USE IN SWEDISH STATIONS.
DESCRIPTORS	DIESEL ENGINES;ELECTRIC GENERATORS;GAS TURBINES;NUCLEAR POWER

PLANTS: T1;PERFORMANCE TESTING;POWER SUPPLIES: T,U1;RELIABILITY;
SWEDEN

D-45

	09/5/0000001-0000061// 44
ACCESSION NO.	79C0006609
TITLE(MONO)	GAS TURBINE APPLICATION IN TRANSIT VEHICLES
TITLE(SERIAL)	SAE PAPER 760059
EDITOR OR COMP	TARRIH, R.A.; BUCKEL, H.M.
SEC REPT NO	CONF-760208--33
PAGE NO	14
CONF TITLE	SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION
CONF PLACE	DETROIT, MI, USA
CONF DATE	FEB 1976
PUBL LOC	SOCIETY OF AUTOMOTIVE ENGINEERS, INC., WARRENDALE, PA
DATE	1976
CATEGORIES	EDB-330103
PRIMARY CAT	EDB-330103
ABSTRACT	DURING THE ENGINEERING AND PUBLIC DEMONSTRATION TESTING PHASES OF THE TRANSBUS PROGRAM, THE THREE PROTOTYPE COACHES EQUIPPED WITH GAS TURBINE POWERPLANTS EXHIBITED SOME ADVANTAGEOUS OPERATIONAL CHARACTERISTICS THAT WARRANTED FURTHER INVESTIGATION. CONSEQUENTLY, THE GAS TURBINE ENGINE WAS INVESTIGATED AS A POTENTIAL POWER SOURCE FOR TRANSIT COACHES. AN IN-DEPTH SURVEY WAS CONDUCTED OF GAS TURBINE ENGINE MANUFACTURERS, WHOSE PRODUCTS MAY BE SUITABLE FOR TRANSIT COACHES, TO DETERMINE THEIR MERITS AS COMPARED TO THOSE OF THE DIESEL ENGINE. ONLY DETROIT DIESEL ALLISON DIVISION (DDAD) HAS A PRODUCT SUFFICIENTLY DEVELOPED TO WARRANT SERIOUS CONSIDERATION OF VOLUME PRODUCTION. THE INVESTIGATION INDICATES THAT WHILE CURRENT ENGINES ARE NOT ECONOMICALLY JUSTIFIABLE, THE GAS TURBINE ENGINE MAY BE POTENTIALLY SUPERIOR TO THE DIESEL.
DESCRIPTORS	BUSES: T1;COMPARATIVE EVALUATIONS;COST;DIESEL ENGINES;FUEL CONSUMPTION: Q2;GAS TURBINES: T2,U1;MAINTENANCE;MANUFACTURING; PERFORMANCE TESTING;PRODUCTION;TECHNOLOGY ASSESSMENT: U2

D-46

ACCESSION NO.	79C0006602
TITLE(MONO).	DENSIFIED SILICON CARBIDE: AN INTERESTING MATERIAL FOR DIESEL APPLICATIONS
TITLE(SERIAL)	SAE PAPER 760071
EDITOR OR COMP	TORTI, M.L.; LUCEK, J.W.; WEAVER, G.Q.
SEC REPT NO	CONF-760208--36
PAGE NO	13
CONF TITLE	SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION
CONF PLACE	DETROIT, MI, USA
CONF DATE	FEB 1976
PUBL LOC	SOCIETY OF AUTOMOTIVE ENGINEERS, INC., WARRENDALE, PA
DATE	1976
CATEGORIES	EDB-330102;360200
PRIMARY CAT	EDB-330102
ABSTRACT	ONE CLASS OF CERAMIC MATERIALS THAT IS BEING CONSIDERED FOR APPLICATION IN DIESEL ENVIRONMENT IS THE DENSIFIED SILICON CARBIDE. THE COMPOSITION, MICROSTRUCTURE, PHYSICAL AND MECHANICAL PROPERTIES OF SEVERAL MEMBERS OF THIS FAMILY OF MATERIALS ARE DISCUSSED ALONG WITH ILLUSTRATIONS OF THE CURRENT STATE OF THE ART OF COMPONENT COMPLEXITY.
DESCRIPTORS	DENSITY;DIESEL ENGINES: T1;MANUFACTURING: U2;MATERIALS: U1; MICROSTRUCTURE;PHYSICAL PROPERTIES: U2;SILICON CARBIDES: T2; USES

D-47

ACCESSION NO.	79R0002750
TITLE(MONO)	ENERGY USE AND OTHER COMPARISONS BETWEEN DIESEL AND GASOLINE PICKUP TRUCKS. INTERIM REPORT OCT 76--JUN 77
EDITOR OR COMP	JACOBS, K.M.
CORPORATE AUTH	MAINE DEPT. OF TRANSPORTATION, BANGOR (USA). MATERIALS AND RESEARCH DIV.
PAGE NO	25
AVAILABILITY	NTIS PC A02/MF A01.
CONTRACT NO	CONTRACT DOT-TSC-1299
DATE	JAN 1976

CATEGORIES	EDB-330102
PRIMARY CAT	EDB-330102
REPORT NO	PB--277464
ABSTRACT	THE PRIMARY GOAL OF THE STUDY WAS TO DETERMINE FUEL ECONOMIES, COST ECONOMIES AND RELIABILITY DIFFERENCES BETWEEN THE GASOLINE AND DIESEL ENGINES USED IN LIGHT DUTY PICKUP TRUCKS.
DESCRIPTORS	COMPARATIVE EVALUATIONS;COST;DIESEL ENGINES: T2,Q1;FUEL ECONOMY: Q2;GASOLINE;RELIABILITY: Q2;SPARK IGNITION ENGINES; TRUCKS: T1

D-48

ACCESSION NO.	79C0001658
TITLE	DORMANCY VS. OVER-TESTING AND THE EFFECT ON DIESEL GENERATOR AVAILABILITY
AUTHORS	BOOTH, L.E.
AUTHOR AFF	BECHTEL POWER CORP., NORWALK, CA
TITLE(MONO)	IEEE POWER ENGINEERING SOCIETY. PAPERS FROM THE JOINT POWER GENERATION CONFERENCE
SEC REPT NO	CONF-760944--
PAGE NO	6P. PAPER A 76 619-7
CONF TITLE	IEEE-ASME JOINT POWER GENERATION CONFERENCE
CONF PLACE	BUFFALO, NY, USA
CONF DATE	19 SEP 1976
PUBL LOC	INST. OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC., NEW YORK
DATE	1977
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
AUGMENTATION	EMERGENCY USE
ABSTRACT	A MATHEMATICAL MODEL IS DEVELOPED DESCRIBING THE EFFECTS OF FREQUENCY OF TESTING, PERIODS OF DORMANCY, PERIODS OF ACTIVE OPERATION AND PERIODS OF DOWNTIME FOR MAINTENANCE ON DIESEL GENERATOR AVAILABILITY. THE MATHEMATICAL MODEL OPTIMIZES AVAILABILITY WITH RESPECT TO TEST INTERVALS. THE MATHEMATICAL MODEL IS EXERCISED USING DATA FROM **DIESEL GENERATOR OPERATING EXPERIENCE AT NUCLEAR POWER PLANTS** (AEC DOCUMENT NO. OOE-ES-002 JUNE 1974). THE POSSIBILITY OF NONCONSTANT DORMANT AND ACTIVE FAILURE RATES IS DISCUSSED ALONG WITH THE POTENTIAL IMPACT ON FUTURE DIESEL GENERATOR AVAILABILITY STUDIES.
DESCRIPTORS	AVAILABILITY: Q2,Q3;DIESEL ENGINES: M3;ELECTRIC GENERATORS: M2,Q1;FAILURES;MAINTENANCE: Q2;MATHEMATICAL MODELS;OPERATION; OPTIMIZATION;PERFORMANCE TESTING;THERMAL POWER PLANTS: T1;TIME DEPENDENCE

D-49

ACCESSION NO.	78J0128062
TITLE	ALTERNATIVE AUTOMOBILE ENGINES
AUTHORS	WILSON, D.G.
AUTHOR AFF	MASSACHUSETTS INST. OF TECH., CAMBRIDGE
PUB DESC	SCI. AM., V. 239, NO. 1, PP. 39-49
DATE	JUL 1978
CATEGORIES	EDB-330100;330200;298000
PRIMARY CAT	EDB-330100
ABSTRACT	A TECHNOLOGY ASSESSMENT OF VARIOUS HEAT ENGINES FOR AUTOMOBILE PROPULSION IS PRESENTED COVERING: THE SPARK IGNITION (OTTO) ENGINE; THE COMPRESSION IGNITION (DIESEL) ENGINE; THE VAPOR CYCLE (RANKINE) ENGINE; THE STIRLING ENGINE; AND THE OPEN AND CLOSED BRAYTON CYCLE (GAS TURBINES) ENGINES. COMPARATIVE DATA GIVEN INCLUDE TEMPERATURE RATIO, THERMAL EFFICIENCY, POWER TO MASS RATIO, EXHAUST EMISSIONS, AND MANUFACTURING COST. THE DEFECTS OF ALTERNATIVE ENGINES TO THE SPARK IGNITION ENGINE ARE CLEARER THAN THEIR VIRTUES, AND THE CHOICE OF A SINGLE BEST ALTERNATIVE IS COMPLEX. GOVERNMENT POLICIES WITH RESPECT TO THE AUTOMOTIVE INDUSTRY ARE DISCUSSED. (PMA)
DESCRIPTORS	AUTOMOBILES: T1;COST;DIESEL ENGINES;EXHAUST GASES;GAS TURBINES; GOVERNMENT POLICIES;HEAT ENGINES: T2,Q1;POWER;RANKINE CYCLE ENGINES;SPARK IGNITION ENGINES;STIRLING ENGINES;STRATIFIED CHARGE ENGINES;TECHNOLOGY ASSESSMENT: Q2;THERMAL EFFICIENCY; THERMODYNAMICS

D-50

ACCESSION NO.	78C0124526
TITLE(MONO)	ELECTRIFYING THE BURLINGTON NORTHERN RAILROAD. PAPER NO. 77HU
EDITOR OR COMP	CHAVEN, L.R.
SEC REPT NO	CONF-770486--8
PAGE NO	17
AVAILABILITY	$1.00
CONF TITLE	ELECTRIC VEHICLE EXPOSITION AND CONFERENCE
CONF PLACE	CHICAGO, IL, USA
CONF DATE	26 APR 1977
PUBL LOC	ELECTRIC VEHICLE COUNCIL, NEW YORK
DATE	1977
CATEGORIES	EDB-330300
PRIMARY CAT	EDB-330300
ABSTRACT	THE INCREASED COST OF PETROLEUM FUELS, THE PROJECTED PROSPECT OF A CONTINUAL SHORTAGE OF CRUDE OIL FOR YEARS TO COME, AND THE QUESTION OF HOW LONG THE SUPPLY WILL LAST HAVE CAUSED RENEWED INTEREST IN ELECTRIFYING RAILWAYS. RECENT TECHNOLOGY ADVANCEMENTS IN THE FIELD INCLUDE THE AC RECTIFIER LOCOMOTIVE, THYRISTOR PROPULSION CONTROL, INDIVIDUAL AXLE WHEEL SLIP

CONTROL, AND VACUUM CIRCUIT BREAKERS. THE BENEFITS OF RAILROAD ELECTRIFICATION ARE: REDUCED LOCOMOTIVE MAINTENANCE COSTS; LONGER LIFE (30 YEARS FOR ELECTRIC VS 15 YEARS FOR THE DIESEL); INCREASED RELIABILITY OF SERVICE; SOME INCREASE IN LINE CAPACITY; OVERLOAD CAPABILITY FOR ACCELERATION; MORE TRACTIVE EFFORT; AND MORE STABLE LONG-TERM ENERGY COSTS. (PMA)

DESCRIPTORS — COMPARATIVE EVALUATIONS;DESIGN;DIESEL ENGINES;ECONOMICS; ELECTRIC RAILWAYS: T1;ENERGY CONSERVATION;FEASIBILITY STUDIES: Q1;LIFE-CYCLE COST;MAINTENANCE;PERFORMANCE;TECHNOLOGY ASSESSMENT

D-51

ACCESSION NO.	78J0110125
TITLE	BRITISH UTILITY TO BUILD TOTAL ENERGY SCHEME
AUTHORS	JENKINS, N.
PUB DESC	ENERGY INT., V. 15, NO. 7, PP. 37-39
DATE	JUL 1978
CATEGORIES	EDB-290800;320603
PRIMARY CAT	EDB-290800
ABSTRACT	A NEW DIESEL POWER STATION THAT WILL SUPPLY INDUSTRIAL PROCESS HEAT WAS ANNOUNCED BY THE BRITISH MIDLANDS ELECTRICITY BOARD AND HAS THE POTENTIAL FOR HAVING SIGNIFICANT INTERNATIONAL IMPACT IF COMBINED HEAT AND POWER BECOMES ACCEPTED. THE AUTHOR TRACES THE DEVELOPMENT OF COMBINED HEAT AND POWER SCHEMES SINCE THE EARLY 1900S AND ANALYZES THEIR FAILURE AS A LACK OF FORESIGHT ON THE PART OF INDUSTRY IN NOT ACKNOWLEDGING THE TECHNICAL AND ECONOMIC FEASIBILITY. THE NEW DIESEL PLANT, WHICH WILL SUPPLY PROCESS HEAT TO TWO INDUSTRIAL PLANTS IN ADDITION TO 15-MW POWER, WILL HAVE A 76% THERMAL EFFICIENCY. THE CITY OF HEREFORD IS ALSO INTERESTED IN SUPPLYING HEAT FROM THE PLANT TO NEIGHBORING BUILDINGS. THE 3.76-MILLION-POUND INVESTMENT IS EXAMINED IN TERMS OF PROJECTED FUEL PRICES AND IS FOUND ACCEPTABLE.
DESCRIPTORS	BOILERS;CO-GENERATION: T2.04;COST;DIESEL ENGINES: T1.02.03; DUAL-PURPOSE POWER PLANTS: T3.01;EFFICIENCY;FEASIBILITY STUDIES; FUELS;INDUSTRIAL PLANTS;PROCESS HEAT;TECHNOLOGY ASSESSMENT; TECHNOLOGY UTILIZATION;UNITED KINGDOM: T4

D-52

ACCESSION NO.	78J0109177
TITLE	DIESEL: THE ENGINE FOR HIGH MILEAGE LIGHT VEHICLES
AUTHORS	FRENCH, C.C.J.
AUTHOR AFF	RICARDO AND CO., SUSSEX, ENG.
PUB DESC	DIESEL GAS TURBINE PROG., V. 46, NO. 6, PP. 77-79
DATE	JUN 1978
CATEGORIES	EDB-330102;330700
PRIMARY CAT	EDB-330102
ABSTRACT	THE ADVANTAGES AND DISADVANTAGES OF THE FUTURE USE OF AUTOMOBILE DIESEL ENGINES ARE DISCUSSED AND ARE COMPARED TO THOSE OF POTENTIAL SPARK IGNITION ENGINES. TOPICS CONSIDERED INCLUDE FUEL ECONOMY, EXHAUST EMISSIONS (HC, NO/SUB X/, CO, AND SO/SUB X/), ENGINE WEIGHT, INITIAL AND OPERATING COSTS, PERFORMANCE, AND FUEL INJECTION. (PMA)
DESCRIPTORS	AUTOMOBILES: T1;CARBON MONOXIDE;COMPARATIVE EVALUATIONS;COST; DIESEL ENGINES: T1;EXHAUST GASES;FUEL ECONOMY;FUEL INJECTION SYSTEMS;HYDROCARBONS;NITROGEN OXIDES;PERFORMANCE;SPARK IGNITION ENGINES;SULFUR OXIDES;TECHNOLOGY ASSESSMENT: Q2;WEIGHT

D-53

ACCESSION NO.	78J0098284
TITLE	DESIGNING ADIABATIC ENGINE COMPONENTS
AUTHORS	STANG, J.H.
AUTHOR AFF	CUMMINS ENGINE CO. INC. COLUMBUS, INDIANA
PUB DESC	SAE PREPR., NO. 780069, P. VP
DATE	1978
CATEGORIES	EDB-421000
PRIMARY CAT	EDB-421000
ABSTRACT	IN THE ADIABATIC ENGINE, THERMAL ENERGY, NORMALLY LOST TO THE COOLING WATER, WOULD BE CONVERTED TO USEFUL ENERGY BY A TURBOMACHINE IN THE EXHAUST GAS STREAM. PARASITIC LOSSES NORMALLY ASSOCIATED WITH COOLING SYSTEM PUMPING COULD BE REDUCED OR ELIMINATED. THEORY PREDICTS A POSSIBLE IMPROVEMENT OF UP TO 20 PERCENT IN THERMAL EFFICIENCY OVER ADVANCED CONVENTIONAL DIESEL ENGINES. THIS PAPER DETAILS THE ANALYTICAL PROCEDURE TO BE USED IN DESIGNING ADIABATIC ENGINE COMBUSTION CHAMBER COMPONENTS WITH SPECIAL EMPHASIS PLACED ON THERMAL ANALYSIS. AN ADIABATIC ENGINE PISTON DESIGN IS PRESENTED. THE AXISYMMETRIC ANALYSIS OF THE PISTON UTILIZED THE DERIVED AND MEASURED BOUNDARY CONDITIONS. INITIAL ENGINE TESTS OF THE ADIABATIC ENGINE PISTON INDICATE THAT THE CERAMIC-CAPPED DESIGN IS VIABLE.
DESCRIPTORS	ADIABATIC PROCESSES;BOUNDARY CONDITIONS;CERAMICS;COMBUSTION CHAMBERS;DESIGN: Q1;DIAGRAMS;DIESEL ENGINES: T1;EXHAUST GASES; FUEL ECONOMY;HEAT RECOVERY: Q1;HEAT TRANSFER;MASS TRANSFER; PISTONS;TESTING;THERMAL EFFICIENCY;THERMAL INSULATION; TURBOMACHINERY;VERY HIGH TEMPERATURE

D-54

ACCESSION NO.	76J0090511
TITLE	NEW DEUTZ MEDIUM-SPEED DESIGN
PUB DESC	DIESEL ENG.. V. 74. NO. 796. PP. 25-27
DATE	SPR 1976
CATEGORIES	EDB-330603;330102;200104;421000
PRIMARY CAT	EDB-330603
ABSTRACT	THE DESIGN OF AN ECONOMICAL DIESEL ENGINE FOR BOTH MARINE AND STATIONARY APPLICATIONS IS DESCRIBED. OPERATING ECONOMY IS CHARACTERIZED BY THE FOLLOWING CRITERIA: (1) LOW FUEL AND LUBRICATING OIL CONSUMPTIONS; (2) LONG SERVICE LIFE AND RELIABILITY; (3) EASE OF MAINTENANCE AND OPERATION; (4) NEGLIGIBLE ENVIRONMENTAL NUISANCE BY EXHAUST AND NOISE EMISSIONS; AND (5) OPTIMUM ADAPTATION TO INDIVIDUAL APPLICATIONS. ON THE TESTBED. THE EIGHT-CYLINDER IN-LINE PROTOTYPE SHOWED A LOW FUEL CONSUMPTION OF ABOUT 209 G/KWH AT FULL LOAD ON 41.9 KJ/G GAS OIL. EQUIVALENT TO A THERMAL EFFICIENCY OF 41%.
DESCRIPTORS	DESIGN: Q3;DIESEL ENGINES: T3.Q1.Q2;FOSSIL-FUEL POWER PLANTS: T1;FUEL CONSUMPTION;LUBRICATING OILS;MAINTENANCE;MARITIME TRANSPORT: T2;OPERATION;RELIABILITY;SERVICE LIFE

D-55

ACCESSION NO.	78J0069320
TITLE	SLOW-SPEED DIESEL POWER PLANTS
AUTHORS	GUERY. R.; SCHLACHTER. H.P.
PUB DESC	DIESEL ENG.. V. 74. NO. 796. PP. 21-22. 24. 16
DATE	SPR 1976
CATEGORIES	EDB-200104
PRIMARY CAT	EDB-200104
ABSTRACT	DUE TO ITS BASIC DESIGN. THE SLOW-SPEED DIESEL HAS MUCH FEWER MOVING PARTS THAN THE MEDIUM-SPEED DIESEL. AND THUS NATURALLY HIGHER RELIABILITY. OPERATING STATISTICS INDICATE THAT WHILE DIESEL ENGINES MAY BE SUBJECT TO A GREATER NUMBER OF NON-SCHEDULED STOPPAGES THAN STEAM TURBINES. THE DURATION OF ANY PROBLEM WITH THE DIESEL IS USUALLY MUCH SHORTER. THE NET RESULT IS THAT TOTAL DOWN TIME OF THE DIESEL IS CONSIDERABLY SHORTER THAN THAT OF THE STEAM TURBINE. ANOTHER IMPORTANT FEATURE WITH THE DIESEL IS THAT WITH REGULAR MAINTENANCE. ITS INITIAL OPERATIONAL CHARACTERISTICS (FUEL CONSUMPTION. LUBRICATING OIL CONSUMPTION. ETC.) CAN EASILY BE REINSTATED. HIGH AVAILABILITY AT FULL LOAD. TOGETHER WITH EXCELLENT FUEL ECONOMY. MAKE THE SLOW-SPEED DIESEL THE MOST ECONOMICAL SOLUTION FOR POWER GENERATING IN ITS RANGE. IT IS WELL SUITED TO HEAVY-DUTY. SUSTAINED OPERATION AND HAS AN OUTSTANDING RECORD IN BASE LOAD APPLICATIONS. SLOW-SPEED DIESELS HAVE MINIMAL ENVIRONMENTAL IMPACT AND CAN MEET STRINGENT POLLUTION STANDARDS. THE EXHAUST OF THESE ENGINES IS ALMOST COLORLESS. WITH COMPLETE ABSENCE OF FLY ASH.
DESCRIPTORS	DESIGN;DIESEL ENGINES: T2.Q1;EXHAUST GASES;FOSSIL-FUEL POWER PLANTS: T1;FUEL ECONOMY;MAINTENANCE;OPERATION: Q2;RELIABILITY

D-56

ACCESSION NO.	78C0065317
REPORT NO.PAGE	CONF-770110 PP. 63-77
TITLE	CERAMICS FOR DIESEL ENGINE
AUTHORS	KAMO. R.
AUTHOR AFF	CUMMINS ENGINE CO.. COLUMBUS. IN
TITLE(MONO)	PROCEEDINGS OF THE WORKSHOP ON CERAMICS FOR ADVANCED HEAT ENGINES
PAGE NO	63-77
CONF TITLE	WORKSHOP ON CERAMICS FOR ADVANCED HEAT ENGINES
CONF PLACE	ORLANDO. FL. USA
CONF DATE	24 JAN 1977
DATE	1977
CATEGORIES	EDB-330102;360200
PRIMARY CAT	EDB-330102
REPORT NO	CONF-770110--
ABSTRACT	AN ADIABATIC DIESEL ENGINE CONCEPT FOR ACHIEVING HIGH THERMAL EFFICIENCIES IS PRESENTED IN CONJUNCTION WITH A TURBOCOMPOUND SYSTEM. IMPROVED THERMAL EFFICIENCIES ARE ACHIEVED THROUGH ELIMINATION OF AN ENGINE COOLING WATER SYSTEM AND REDUCTION OF EXHAUST ENERGY LOSSES. THE ''HOT'' ADIABATIC ENGINE CONCEPT WITH INSULATED COMBUSTION CHAMBER OFFERS MANY OTHER ENGINE BENEFITS BESIDES HIGH THERMAL EFFICIENCIES. NOTABLE AMONG THESE

	ARE: MULTI-FUEL CAPABILITY, WEIGHT, SIZE, AND POTENTIAL COST ADVANTAGES. THIS PROGRAM IS SUPPORTED JOINTLY BY CUMMINS ENGINE COMPANY AND TARADCOM OF WARREN, MICHIGAN. SOME OF THE TECHNICAL DIFFICULTIES AND PROBLEMS ENCOUNTERED WHEN WORKING WITH CERAMIC MATERIALS ON THE ADIABATIC ENGINE ARE COVERED. ENGINE TRIBOLOGY IS SINGLED OUT AS THE NEXT PROMISING STEP IN IMPROVING ENGINE EFFICIENCY THROUGH FRICTION REDUCTION AND IMPROVED DURABILITY. THE ABOVE ENGINE CONCEPTS SHOULD CONTRIBUTE GREATLY TO THE NATION'S CONSERVATION EFFORTS.
DESCRIPTORS	CERAMICS: T2;COMBINED CYCLES;DESIGN;DIESEL ENGINES: T1;GAS TURBINES;MATERIALS: Q1;RESEARCH PROGRAMS: Q2;WASTE HEAT UTILIZATION

D-57

ACCESSION NO.	78R0079350
TITLE(MONO)	1970 NATIONAL POWER SURVEY. PART IV. TECHNICAL ADVISORY COMMITTEE REPORTS TO THE FEDERAL POWER COMMISSION
CORPORATE AUTH	FEDERAL POWER COMMISSION, WASHINGTON, D.C. (USA)
PAGE NO	446
AVAILABILITY	GPO $4.00.
DATE	1970
CATEGORIES	EDB-296000
PRIMARY CAT	EDB-296000
AUGMENTATION	FROM GENERATION, TRANSMISSION, DISTRIBUTION, AND LOAD FORECASTING COMMITTEES
REPORT NO	NP--23135
ABSTRACT	THE FEDERAL POWER COMMISSION'S TECHNICAL ADVISORY COMMITTEES ON THE GENERATION, TRANSMISSION, AND DISTRIBUTION OF ELECTRIC POWER AND THE METHODOLOGY OF LOAD FORECASTING PRESENT THE STATE OF THE ARTS, NEEDS, AND PROBABLE FUTURE DEVELOPMENTS, COSTS, AND ECONOMIC FACTORS, AND RESEARCH REQUIREMENTS FROM THE PRESENT TO 1990. (MCW)
DESCRIPTORS	DECISION MAKING;DIESEL ENGINES;ECONOMICS;ELECTRIC POWER: M4;ENVIRONMENTAL EFFECTS;FEDERAL POWER COMMISSION;FORECASTING: Q1,Q3,Q4;FOSSIL-FUEL POWER PLANTS;GAS TURBINES;HYDROELECTRIC POWER PLANTS;LOAD MANAGEMENT: M5;NUCLEAR FUELS;NUCLEAR POWER PLANTS;PERFORMANCE;PLANNING: Q5;POWER GENERATION: M1;POWER TRANSMISSION: M3;PUMPED STORAGE;REGULATIONS;REVIEWS: Q1,Q3;STEAM GENERATION

D-58

ACCESSION NO.	78X0066926
TITLE(MONO)	AUTOMOTIVE DIESEL TECHNOLOGY PROGRAM. FINAL REPORT, JUNE 1975--APRIL 1977
EDITOR OR COMP	HILL, S.H.
CORPORATE AUTH	TELEDYNE CONTINENTAL MOTORS, MUSKEGON, MICH. (USA). GENERAL PRODUCTS DIV.
PAGE NO	124
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT EY-76-C-03-1099
DATE	AUG 1977
CATEGORIES	EDB-330102;330603;330701;330702;330704
PRIMARY CAT	EDB-330102
REPORT NO	SAN--1099-1
ABSTRACT	THE WORK REPORTED WAS PERFORMED UNDER CONTRACT WITH THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION (ERDA), DIVISION OF TRANSPORTATION ENERGY CONSERVATION. THE DIESEL TECHNOLOGY PROGRAM WAS CONDUCTED DURING THE JUNE 1975 THROUGH APRIL 1977 PERIOD. THE PROGRAM PHILOSOPHY WAS TO DESIGN AND DEVELOP A DIESEL ENGINE CONCEPT TO MEET THE ERDA SPECIFICATION FOR A 3000 POUND CAR, AND TO DEMONSTRATE WITH EXISTING HARDWARE, THAT THE TECHNOLOGY OF THE CONCEPT ENGINE COULD MEET THE SPECIFICATION GOALS. THE PRELIMINARY DESIGN WAS FINALIZED FOR A LIGHTWEIGHT AUTOMOTIVE DIESEL THAT CAN MEET ERDA SPECIFICATION GOALS. IT WAS DEMONSTRATED THAT TECHNOLOGY INCLUDED IN THE CONCEPT DESIGN CAN MEET THE EMISSION AND FUEL ECONOMY GOALS OF 0.41HC/3.4 CO/0.4NO/SUB X/ AND 25 MILES PER GALLON ON THE FEDERAL URBAN DRIVING CYCLE. THE MAJOR CONCLUSIONS REACHED DURING THIS PROGRAM ARE THAT A VARIABLE COMPRESSION RATIO (VCR) SWIRL CHAMBER DIESEL WITH VARIABLE INJECTION TIMING AND EXHAUST GAS RECIRCULATION (EGR) CAN: (1) ACHIEVE EMISSIONS OF 0.41 HC/3.4 CO/0.40 NO/SUB X/; (2) HAVE FUEL ECONOMY 55 PERCENT BETTER (MPG) THAN COMPARABLE GASOLINE ENGINES; (3) HAVE AN EARLY INTRODUCTION INTO PRODUCTION OVER PRESENT GASOLINE ENGINE LINES;

(4) HAVE A BROAD FUEL TOLERANCE (UNLEADED GASOLINE WAS RUN); AND (5) BE SMALLER IN SIZE AND COMPARABLE IN WEIGHT TO EXISTING GASOLINE ENGINES.

DESCRIPTORS AIR POLLUTION CONTROL;AUTOMOBILES: T1;AUTOMOTIVE FUELS;CARBON MONOXIDE;COMPRESSION;DESIGN: Q2;DIESEL ENGINES: T2,Q1;EXHAUST GASES: Q2;EXHAUST RECIRCULATION SYSTEMS;FUEL ECONOMY: Q2;FUEL INJECTION SYSTEMS;HYDROCARBONS;NITROGEN OXIDES;RESEARCH PROGRAMS: Q2;WEIGHT

D-59

ACCESSION NO. 78C0064662
REPORT NO.PAGE CONF-770876 PP. 417-438
TITLE ELECTRIFICATION OF RAILROADS PROBLEMS--POTENTIALS--ECONOMIC IMPACTS
AUTHORS MEEKER, M.D.
AUTHOR AFF GENERAL ELECTRIC CO., ERIE, PA
TITLE(MONO) EFFECTS OF ENERGY CONSTRAINTS ON TRANSPORTATION SYSTEMS
EDITOR OR COMP MITTAL, R.K. (ED.)
PAGE NO 417-438
CONF TITLE 4. NATIONAL CONFERENCE ON THE EFFECTS OF ENERGY CONSTRAINT ON TRANSPORTATION SYSTEMS
CONF PLACE SCHENECTADY, NY, USA
CONF DATE 1 AUG 1977
DATE DEC 1977
CATEGORIES EDB-330300;320202;298000;290200
PRIMARY CAT EDB-330300
REPORT NO CONF-770876--
ABSTRACT AN HISTORICAL BACKGROUND IS GIVEN OF RAILROAD ELECTRIFICATION WITHIN THE U.S. DATA ARE ALSO PROVIDED RELATED TO PERCENT ELECTRIFICATION OF RAILROAD ROUTE MILES WITHIN THE MAJOR DEVELOPED COUNTRIES AROUND THE WORLD. AN ATTEMPT IS MADE TO PROVIDE QUANTIFICATION OF THE BENEFITS ACCRUED DUE TO ELECTRIFICATION. THE ECONOMIC AND TECHNICAL CHARACTERISTICS BETWEEN THE DIESEL/ELECTRIC AND ELECTRIC TRAINS ARE COMPARED. THE FOLLOWING ASPECTS OF ELECTRIFICATION ARE OF PRIMARY CONCERN: ELECTRIC LOCOMOTIVES HAVE: $SUP 2$/$SUB 3$ LOWER MAINTENANCE COST; TWICE ECONOMIC LIFE, AND $SUP 1$/$SUB 2$ THE OUT-OF-SERVICE TIME. ALSO LISTED ARE THE COMPONENTS OF COST FOR ELECTRIFICATION, AND DATA ARE PROVIDED ON THE RAIL OF RETURN ESTIMATED UNDER SEVERAL SCENARIOS. IT IS CONCLUDED THAT THE QUESTION BEFORE US IS NOT WHETHER OR NOT TO HAVE THE RAIL ELECTRIFICATION, BUT WHEN.
DESCRIPTORS COMPARATIVE EVALUATIONS;DIESEL ENGINES;ECONOMIC IMPACT: Q1; ELECTRIC RAILWAYS: T1;FEASIBILITY STUDIES;HYBRID ELECTRIC-POWERED VEHICLES;LIFE-CYCLE COST;MAINTENANCE;REVIEWS: Q1;SERVICE LIFE;TECHNOLOGY ASSESSMENT

D-60

ACCESSION NO. 78C0064630
REPORT NO.PAGE CONF-771037 PP. 31-40
TITLE USPS LIGHT DELIVERY VEHICLES PROGRAM
AUTHORS HULL, W.E.
TITLE(MONO) HIGHWAY VEHICLE SYSTEMS
PAGE NO 31-40
CONF TITLE ERDA CONTRACTORS' COORDINATION MEETING
CONF PLACE DETROIT, MI, USA
CONF DATE 4 OCT 1977
DATE MAR 1978
CATEGORIES EDB-330100;330300;330400;080600;250904
PRIMARY CAT EDB-330100
AUGMENTATION U.S. POSTAL SERVICE (USPS)
REPORT NO CONF-771037--
ABSTRACT THE U.S. POSTAL SERVICE HAS A PROGRAM TO LOOK AT IMPROVED VEHICLES AS CANDIDATES FOR USE IN ITS FLEET TO ACHIEVE MINIMUM VEHICLE COSTS AND TO REDUCE THE USE OF, AND DEPENDENCE ON, OIL BASED FUELS. AS PART OF THIS PROGRAM, A NUMBER OF INTERNAL COMBUSTION ENGINES, ELECTRIC AND HYBRID PROPULSION SYSTEMS ARE BEING TESTED AND EVALUATED. SOME OF THE SYSTEMS UNDER EVALUATION ARE DESCRIBED AND SOME OF THE TEST RESULTS TO DATE ARE PRESENTED. SYSTEMS DISCUSSED INCLUDE: DIESEL ENGINES, STRATIFIED CHARGE ENGINES, HYDROGEN-FUELED ENGINES, BATTERY-POWERED SYSTEMS, AND HYBRID BATTERY/FLYWHEEL SYSTEMS.
DESCRIPTORS AUTOMOBILES: M1;DEMONSTRATION PROGRAMS: Q1,Q2,Q3;DIESEL ENGINES; ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES: M2;FLYWHEELS;

HYBRID ELECTRIC-POWERED VEHICLES: M3;HYDROGEN FUELS;PERFORMANCE TESTING;SPARK IGNITION ENGINES;STRATIFIED CHARGE ENGINES

D-61

ACCESSION NO.	78J0064470
TITLE	DESIGN GUIDELINES FOR TOTAL AND SELECTIVE ENERGY SYSTEMS
AUTHORS	GORE, L.; QURESHI, A.S.
AUTHOR AFF	MICHAEL BAKER, JR., INC. NEW YORK, NY
PUB DESC	HEAT., PIPING AIR COND., V. 49, NO. 9, PP. 57-64
DATE	SEP 1977
CATEGORIES	EDB-290800;291000
PRIMARY CAT	EDB-290600
ABSTRACT	A COMPREHENSIVE STUDY WAS MADE TO ESTABLISH DESIGN GUIDELINES AND LIMITATIONS FOR THE SELECTION, EVALUATION, AND DESIGN OF THE ENERGY CONSERVING SYSTEMS TO BE USED IN FUTURE VETERAN'S ADMINISTRATION HOSPITALS. THE STUDY SETS FORTH CONSIDERATIONS THAT MUST BE TAKEN INTO ACCOUNT BY THE DESIGNER IN THE EARLY STAGES OF A PROJECT TO DETERMINE WHAT TYPES OF ENERGY-SAVING SYSTEMS ARE FEASIBLE FOR THAT PROJECT. IT ESTABLISHES DESIGN GUIDELINES AND LIMITATIONS RATHER THAN DETAILED DESIGN PROCEDURES. WHILE THE STUDY WAS PREPARED FOR HOSPITALS, THE CONSIDERATIONS INVOLVED ARE VIRTUALLY THE SAME FOR A WIDE RANGE OF PROJECTS.
DESCRIPTORS	A CODES;BOILERS;COMPUTERS;COST;DESIGN: Q2;DIESEL ENGINES;E CODES;ECONOMICS;ENERGY CONSERVATION;ENVIRONMENTAL EFFECTS; FLOWSHEETS;FOSSIL FUELS;FUEL ECONOMY;GAS TURBINES;HEAT RECOVERY; HOSPITALS: T1;LIFE-CYCLE COST: Q2;MAINTENANCE;NATURAL GAS; PERSONNEL;POLLUTION CONTROL;PUBLIC UTILITIES;RECOMMENDATIONS;T CODES;TOTAL ENERGY SYSTEMS: T2,Q1

D-62

ACCESSION NO.	78R0060370
TITLE(MONO)	COST AND PERFORMANCE OF AUTOMOTIVE EMISSION CONTROL TECHNOLOGIES
EDITOR OR COMP	CASS, G.R.
CORPORATE AUTH	CALIFORNIA INST. OF TECH., PASADENA (USA). ENVIRONMENTAL QUALITY LAB.
PAGE NO	31
AVAILABILITY	CALIFORNIA INST. OF TECH., PASADENA.
DATE	DEC 1973
CATEGORIES	EDB-330701;330702;330704;330603
PRIMARY CAT	EDB-330701
REPORT NO	EQL-MEMO--7
ABSTRACT	AN INVESTIGATION WAS MADE OF THE NEAR-TERM COMMERCIAL FEASIBILITY OF A WIDE RANGE OF AUTOMOTIVE EMISSION CONTROL TECHNOLOGIES. THE CENTRAL ISSUES ARE EXPLAINED IN TERMS OF THE EMISSION CONTROL CHARACTERISTICS OF EACH TECHNOLOGY AND THEIR COSTS. THE DATA INDICATE THAT THE BEST PROVEN EMISSION CONTROL PERFORMANCE OF THE CATALYST-EQUIPPED CONVENTIONAL ENGINE CAN BE EQUALLED OR BETTERED BY AT LEAST ONE VERSION OF EACH OF THE ALTERNATIVE ENGINE DESIGNS. THUS, ANY EXHAUST EMISSION STANDARD WRITTEN SO AS NOT TO EXCLUDE THE CONVENTIONAL ENGINE WITH DUAL-CATALYST EMISSION CONTROLS WILL ALSO BE ATTAINABLE BY SUITABLE DIESEL, WANKEL, OR STRATIFIED-CHARGE ENGINES. A VARIETY OF TECHNOLOGIES WILL THUS PROBABLY BE LEGALLY FEASIBLE IN FUTURE YEARS. GIVEN CURRENT PRICES, THE COLLECTED MARGIN OF ERROR INVOLVED IN THE ASSUMPTIONS MADE TO DETERMINE ANNUAL COST OF OWNERSHIP IS PROBABLY LARGER THAN THE DIFFERENCES IN COST DUE TO EMISSION CONTROL TECHNOLOGY BETWEEN THE CLOSEST COMPETITIVE SOLUTIONS. IN MOST CASES, THE WANKEL ENGINE AT ITS CURRENT STATE OF COMMERCIAL DEVELOPMENT SEEMS SUBSTANTIALLY UNATTRACTIVE DUE TO ITS VERY POOR FUEL ECONOMY. THE REMAINING TECHNOLOGIES PROBABLY COULD BE MARKETED WITHOUT THE AVERAGE CONSUMER BEING ABLE TO DISTINGUISH HIS OPTIMAL CHOICE CLEARLY ON THE BASIS OF COST ALONE. UNLESS FUEL PRICES CLIMB SHARPLY ENOUGH TO PLACE A HIGHER PREMIUM ON VEHICLE FUEL ECONOMY, THE VARIOUS VEHICLE-ENGINE COMBINATIONS DIFFER DRAMATICALLY IN POLLUTION POTENTIAL AND FUEL CONSUMPTION, EVEN THOUGH THE COST-CONSCIOUS NEW CAR CONSUMER MAY BE INDIFFERENT BETWEEN THEM ON THE BASIS OF EMISSIONS ALONE.
DESCRIPTORS	AFTERBURNERS;AIR POLLUTION CONTROL: Q1;AUTOMOBILES: T1;CARBON MONOXIDE;CATALYTIC CONVERTERS;COST: Q2;DIESEL ENGINES;EXHAUST GASES: Q1;EXHAUST RECIRCULATION SYSTEMS;FEASIBILITY STUDIES; HYDROCARBONS;NITROGEN OXIDES;PERFORMANCE;POLLUTION CONTROL EQUIPMENT: T2;STRATIFIED CHARGE ENGINES;WANKEL ENGINES

D-63

ACCESSION NO. 76J0060352
TITLE DENSIFIED SILICON CARBIDE: NEW MATERIAL FOR DIESELS
PUB DESC AUTOMOT. ENG. (N.Y.), V. 86, NO. 3, PP. 34-35
DATE MAR 1976
CATEGORIES EDB-330603;330103
PRIMARY CAT EDB-330603
ABSTRACT DIESEL ENGINE BUILDERS ARE EXPLORING NEW CERAMIC MATERIALS WHICH PROMOTE INCREASED FUEL EFFICIENCY VIA HIGHER OPERATING TEMPERATURES AND REDUCED COOLING REQUIREMENTS. A DISCUSSION IS GIVEN OF DENSIFIED SILICON CARBIDES. CERAMICS OF NON-STRATEGIC MATERIALS AND POTENTIALLY LOW COSTS, WHICH ARE BEING CONSIDERED FOR APPLICATION IN THE DIESEL ENVIRONMENT. THEIR RANGE OF COMPOSITIONS EXHIBITS GOOD THERMAL SHOCK RESISTANCE DUE TO LOW COEFFICIENTS OF EXPANSION, HIGH THERMAL CONDUCTIVITIES, AND GOOD STRENGTH AT BOTH ROOM AND ELEVATED TEMPERATURES. THE COMPOSITIONS ARE IMPERVIOUS THROUGHOUT THEIR USEFUL TEMPERATURE RANGE AND HAVE EXCELLENT RESISTANCE TO OXIDATION. FABRICATION METHODS HAVE BEEN DEVELOPED TO FORM COMPLEX SHAPES WITHOUT THE DIMENSIONAL SHRINKAGE PROBLEMS INHERENT WITH SINTERED MATERIALS. THESE CERAMICS MAY ALSO OFFER IMPROVED LIFE AND PERFORMANCE THROUGH REDUCTIONS IN HOT GAS EROSION-CORROSION.
DESCRIPTORS AUTOMOBILES: T1;CERAMICS;COST;DIESEL ENGINES: T2,01;FABRICATION; FUEL ECONOMY;MATERIALS: 02;MECHANICAL PROPERTIES;SILICON CARBIDES;THERMAL EXPANSION;THERMAL SHOCK

D-64

ACCESSION NO. 76J0050780
TITLE HIGH SPEED DIESEL FOR AUTOS AND LIGHT VEHICLES
AUTHORS EISELE, H.
AUTHOR AFF ROBERT BOSCH GMBHR, STUTTGART
PUB DESC DIESEL GAS TURBINE PROG., V. 46, NO. 2, PP. 14-16
DATE FEB 1976
CATEGORIES EDB-330102;330701;330702;330704
PRIMARY CAT EDB-330102
ABSTRACT THE USE OF DIESEL ENGINES FOR PASSENGER CARS IS DISCUSSED, AND VARIOUS PERFORMANCE PARAMETERS OF THE DIESEL ENGINE ARE COMPARED WITH THOSE OF GASOLINE ENGINES AND ELECTRIC MOTORS. COMPARATIVE DATA GIVEN INCLUDE: (1) OUTPUT POWER/WEIGHT; (2) OUTPUT POWER/SPACE; (3) EFFICIENCY; (4) FUEL CONSUMPTION; AND (5) EXHAUST GASES (CO, HC, AND NO/SUB X/). (PMA)
DESCRIPTORS AIR POLLUTION CONTROL;AUTOMOBILES: T1;CARBON MONOXIDE; COMPARATIVE EVALUATIONS;DIESEL ENGINES: T2,01;EFFICIENCY; ELECTRIC MOTORS;EXHAUST GASES;FUEL CONSUMPTION;HYDROCARBONS; NITROGEN OXIDES;PERFORMANCE: 02;POWER;SIZE;SPARK IGNITION ENGINES;WEIGHT

D-65

ACCESSION NO. 76J0048035
TITLE HOW TO KEEP DIESEL ENGINES AT PEAK EFFICIENCY
AUTHORS BLY, R.L.
AUTHOR AFF FIAT-ALLIS CONSTR MACH, INC, SPRINGFIELD, ILL
PUB DESC COAL MIN. PROCESS., V. 14, NO. 8, PP. 72-74, 84-85
DATE AUG 1977
CATEGORIES EDB-012000
PRIMARY CAT EDB-012000
ABSTRACT ABERRATIONS IN THE COLOR, PRESSURE AND TEMPERATURE OF A DIESEL ENGINE'S EXHAUST ARE THE SYMPTOMS OF INTERNAL MALFUNCTIONS, MOST OF WHICH CAN BE EASILY CORRECTED BY REGULAR CHECKS AND MAINTENANCE, AS SHOWN IN THIS ARTICLE. AFTER SUGGESTING THE WAYS OF EXAMINING PERFORMANCE AND COMBUSTION EFFICIENCY OF MODERN DIESEL ENGINES USED FOR SURFACE MINING OR CONSTRUCTION MACHINERY, THE AUTHOR DISCUSSES SOME OF THE COMMON TROUBLE AREAS AND OFFERS BASIC GUIDELINES FOR CORRECTING MALFUNCTIONS IN THE AIR RESTRICTION FROM PLUGGED AIR CLEANERS, FUEL DELIVERY, VALVE OPERATIONS AND COMPRESSION.
DESCRIPTORS COAL MINING;DIESEL ENGINES: T3;DIESEL FUELS;EFFICIENCY;EXHAUST GASES;MAINTENANCE: 03;MINING EQUIPMENT: 01;PERFORMANCE;PRESSURE MEASUREMENT;SURFACE MINING: T1;TEMPERATURE MEASUREMENT;USES; VALVES

D-66

ACCESSION NO. 76J0044507
TITLE TECHNICAL HIGHLIGHTS OF EUROPEAN VEHICLE DESIGNS
AUTHORS SCOTT, D.

PUB DESC AUTOMOT. ENG. (N.Y.), V. 86, NO. 1, PP. 16-31
DATE JAN 1978
CATEGORIES EDB-330600;330101;330102;330103
PRIMARY CAT EDB-330600
ABSTRACT A REPORT IS GIVEN ON RECENT AUTOMOTIVE TECHNOLOGY ADVANCEMENTS IN ENGLAND, GERMANY, SWEDEN, AND ITALY ENCOMPASSING FUEL ECONOMY, ENGINE DESIGN, MATERIALS, DIESEL TECHNOLOGY, ELECTRONICS, AND OTHER AREAS. DESCRIBED ARE: (1) A DUAL-CIRCUIT BRAKING SYSTEM; (2) A COIL-LESS AMMETER; (3) TRUCK NOISE REDUCTION; (4) BUMPERS WITH HYDRAULIC RETARDERS; (5) A SMALLER SPARK IGNITION ENGINE DESIGN; (6) A DIESEL INJECTION PUMP; (7) LIQUID NITROGEN DRIVEN VEHICLES; (8) ELECTRONIC SENSORS FOR WHEEL ALIGNMENT; (9) AIRFOILS FOR TRUCK DRAG REDUCTION; (10) A TURBOCHARGED AUTOMOBILE DIESEL ENGINE; (11) A SIX-SPEED AUTOMATIC TRANSMISSION FOR TRUCKS; (12) DUAL PULLEYS FOR ENGINE AUXILIARIES; AND (13) CERAMIC PARTS FOR A THREE-STAGE GAS TURBINE. (PMA)
DESCRIPTORS AIRFOILS;AMMETERS;AUTOMOBILES: T1;BRAKES;CERAMICS;CRYOGENIC FLUIDS;DESIGN: 01,02;DIESEL ENGINES;ELECTRONIC EQUIPMENT;FUEL ECONOMY;FUEL INJECTION SYSTEMS;GAS TURBINES;GERMAN FEDERAL REPUBLIC;ITALY;MAINTENANCE;MATERIALS;MECHANICAL TRANSMISSIONS; NOISE POLLUTION CONTROL;SAFETY;SPARK IGNITION ENGINES; SUPERCHARGERS;SWEDEN;TRUCKS: T2;UNITED KINGDOM

D-67 ACCESSION NO. 78J0044479
TITLE SYNTHETIC DIESEL LUBE OFFERS REDUCED OPERATING COSTS
AUTHORS SCHULZ, B.
PUB DESC DIESEL GAS TURBINE PROG., V. 43, NO. 12, P. 16
DATE DEC 1977
CATEGORIES EDB-330102;320303
PRIMARY CAT EDB-330102
ABSTRACT A NEW ENGINE LUBRICANT FOR VEHICULAR AND INDUSTRIAL POWER EQUIPMENT WAS DEVELOPED TO PROVIDE 100,000 MILES OF DIESEL OPERATION PRIOR TO DRAIN AND WAS FLEET TESTED IN EXCESS OF THIS DRAIN INTERVAL. THE LUBRICANT DEMONSTRATED REDUCED FUEL CONSUMPTION AND MEASURABLY IMPROVED DIESEL STARTING IN COLD WEATHER OPERATION. THE LUBRICANT, CALLED DELVAC 1, IS A 100% SYNTHETIC-BASED ENGINE OIL COMBINING SYNTHETIC HYDROCARBONS AND ESTERS PLUS ADDITIVES THAT IMPROVE PERFORMANCE.
DESCRIPTORS AUTOMOBILES: T1;DIESEL ENGINES: T3,01,02;FUEL ECONOMY: 03; INDUSTRY: T2;LUBRICANTS: 03;PHYSICAL PROPERTIES;START-UP

D-68 ACCESSION NO. 78Y0044470
TITLE DEVICES FOR DIRECT PRODUCTION OF MECHANICAL ENERGY
TITLE(MONO) EFFICIENT USE OF ENERGY
EDITOR OR COMP DRYDEN, I.G.C. (ED.)
PAGE NO 272-285
PUBL LOC IPC SCIENCE AND TECHNOLOGY PRESS LTD., GUILDFORD, ENG.
DATE 1975
CATEGORIES EDB-330100;320303
PRIMARY CAT EDB-330100
ABSTRACT NONE
DESCRIPTORS AUTOMOTIVE FUELS;AVAILABILITY;COST;DIESEL ENGINES;EXHAUST GASES; GAS TURBINES: T2;HEAT RECOVERY;INDUSTRY;INTERNAL COMBUSTION ENGINES: T1;MAINTENANCE;NOISE;OPERATION;REVIEWS: 01,02;SPARK IGNITION ENGINES;USES

D-69 ACCESSION NO. 78R0044436
TITLE(MONO) INTERNAL COMBUSTION PISTON ENGINES
EDITOR OR COMP SEGASER, C.L.
CORPORATE AUTH OAK RIDGE NATIONAL LAB., TENN. (USA)
PAGE NO 85
AVAILABILITY DEP. NTIS, PC A05/MF A01.
CONTRACT NO CONTRACT W-31-109-ENG-38
DATE JUL 1977
CATEGORIES EDB-320603;330100
PRIMARY CAT EDB-320603
REPORT NO ANL/CES/TE--77-1
ABSTRACT CURRENT WORLDWIDE PRODUCTION OF INTERNAL COMBUSTION PISTON ENGINES INCLUDES MANY DIVERSIFIED TYPES OF DESIGNS AND A VERY BROAD RANGE OF SIZES. ENGINE SIZES RANGE FROM A FEW HORSEPOWER

IN SMALL MOBILE UNITS TO OVER 40,000 BRAKE HORSEPOWER IN LARGE STATIONARY AND MARINE UNITS. THE KEY CHARACTERISTICS OF INTERNAL COMBUSTION PISTON ENGINES CONSIDERED APPROPRIATE FOR USE AS PRIME MOVERS IN INTEGRATED COMMUNITY ENERGY SYSTEMS (ICES) ARE EVALUATED. THE CATEGORIES OF ENGINES CONSIDERED INCLUDE SPARK-IGNITION GAS ENGINES, COMPRESSION-IGNITION OIL (DIESEL) ENGINES, AND DUAL-FUEL ENGINES. THE ENGINES ARE EVALUATED WITH RESPECT TO FULL-LOAD AND PART-LOAD PERFORMANCE CHARACTERISTICS, RELIABILITY, ENVIRONMENTAL CONCERNS, ESTIMATED 1976 COST DATA, AND CURRENT AND FUTURE STATUS OF DEVELOPMENT. THE LARGEST INTERNAL COMBUSTION PISTON ENGINES MANUFACTURED IN THE UNITED STATES RANGE UP TO 13,540 RATED BRAKE HORSEPOWER. FUTURE DEVELOPMENT EFFORTS ARE ANTICIPATED TO RESULT IN A 20 TO 25% INCREASE IN BRAKE HORSEPOWER WITHOUT INCREASE IN OR LOSS OF WEIGHT, ECONOMY, RELIABILITY, OR LIFE EXPECTANCY, PREDICATED ON A SIMPLE EXTENSION OF CURRENT DEVELOPMENT TRENDS.

DESCRIPTORS: COST;DIESEL ENGINES: T3,01;DUAL-FUEL ENGINES: T4,01; ENVIRONMENTAL IMPACTS;FORECASTING;ICES: T1;PERFORMANCE;PISTONS; RELIABILITY;SPARK IGNITION ENGINES: T2,01;TECHNOLOGY ASSESSMENT: Q2,03,04

D-70

ACCESSION NO.: 78C0043718
TITLE: METHOD OF COMBINING DIESEL-GENERATOR SET DETAILED COMPONENT MODELS INTO A COMPOSITE MODEL
AUTHORS: PEARCE, W.S.
AUTHOR AFF: SOUTH CO SERV, INC, BIRMINGHAM, ALA
TITLE(MONO): PROCEEDINGS OF THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS CONFERENCE
PAGE NO: 16-20
CONF TITLE: INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS CONFERENCE
CONF PLACE: WILLIAMSBURG, VA, USA
CONF DATE: 4 APR 1977
PUBL LOC: INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, NEW YORK
DATE: 1977
CATEGORIES: EDB-210900
PRIMARY CAT: EDB-210900
AUGMENTATION: NUCLEAR POWER PLANTS
ABSTRACT: THE ABILITY TO CALCULATE ACCURATELY THE DYNAMIC RESPONSE OF A DIESEL-GENERATOR SET USED IN NUCLEAR POWER PLANTS IS OF INCREASING IMPORTANCE TODAY. A DESCRIPTION IS GIVEN OF A METHOD OF COMBINING DETAILED COMPONENT MODELS INTO A COMPOSITE DIESEL GENERATOR SET MODEL WHICH CAN THEN BE PROGRAMMED INTO A DIGITAL COMPUTER FOR CALCULATING ACCURATE AND RAPID RESULTS. 7 REFS.
DESCRIPTORS: CALCULATION METHODS;DIESEL ENGINES: M2,01;ELECTRIC GENERATORS; MATHEMATICAL MODELS;NUCLEAR POWER PLANTS: T1;RELIABILITY: Q2

D-71

ACCESSION NO.: 76J0037632
TITLE: ADIABATIC DIESEL ENGINE
AUTHORS: BRYZIK, W.
AUTHOR AFF: ARMY TANK-AUTOMOTIVE RESEARCH AND DEVELOPMENT COMMAND, WARREN, MI
PUB DESC: RES./DEV., V. 29, NO. 1, PP. 34-36, 39-40
DATE: JAN 1978
CATEGORIES: EDB-330603;330102
PRIMARY CAT: EDB-330603
ABSTRACT: A RESEARCH PROGRAM FOR AN INNOVATIVE, HIGH PAYOFF CONCEPT CALLED THE ADIABATIC DIESEL ENGINE IS DESCRIBED. THIS ENGINE CONCEPT INSULATES THE DIESEL COMBUSTION CHAMBER WITH HIGH TEMPERATURE MATERIALS TO ALLOW **HOT** OPERATION NEAR AN ADIABATIC OPERATING CONDITION. THE **HOT** OR INSULATED HIGH TEMPERATURE COMPONENTS INCLUDE PISTON, CYLINDER HEAD, VALVES, CYLINDER LINER AND EXHAUST PORTS. ADDITIONAL POWER AND IMPROVED EFFICIENCY DERIVED FROM THIS CONCEPT OCCUR BECAUSE THERMAL ENERGY, NORMALLY LOST TO THE COOLING WATER AND EXHAUST GAS, IS CONVERTED TO USEFUL POWER THROUGH THE USE OF TURBOMACHINERY AND HIGH TEMPERATURE MATERIALS. BY GREATLY REDUCING LOST ENERGY AND ESSENTIALLY ELIMINATING THE NEED FOR A CONVENTIONAL COOLING SYSTEM, THIS ENGINE WILL DRAMATICALLY IMPROVE FUEL ECONOMY OR INCREASE POWER FOR THE SAME FUEL INPUT BY 30% OVER CURRENT HIGHLY EFFICIENT DIESEL ENGINES AND WILL RESULT IN APPROXIMATELY A 40% REDUCTION IN BOTH WEIGHT AND VOLUME FOR THE SAME HORSEPOWER LEVEL. ENGINE DESIGN, MATERIALS, AND MATERIALS

	TESTING TECHNIQUES ARE DISCUSSED.
DESCRIPTORS	CERAMICS;DESIGN;DIESEL ENGINES: T1;MATERIALS;MATERIALS TESTING; PISTONS;PLANNING;RESEARCH PROGRAMS: Q1;THERMAL EFFICIENCY

D-72

ACCESSION NO.	78J0037616
TITLE	ELECTRIFICATION FOR ENVIRONMENTALISTS. I AND II
AUTHORS	OGILVIE, J.R.
PUB DESC	MOD. RAILW., PP. 320-323
DATE	AUG 1975
CATEGORIES	EDB-330300;250904
PRIMARY CAT	EDB-330300
ABSTRACT	A REVIEW IS GIVEN OF THE HISTORY AND CURRENT STATUS OF ELECTRIC RAILWAYS. ENVIRONMENTAL IMPACTS ARE CONSIDERED, AND OVERHEAD ELECTRIFICATION, ELECTRIC BATTERIES, DIESEL ENGINES, AND GAS TURBINES ARE CONSIDERED AS ELECTRIC POWER SOURCES. THE DIRECT CURRENT TRACTION MOTOR IS BELIEVED TO BE THE BEST MEANS TO DRIVE THE WHEELS, BUT AC SYSTEMS ARE ALSO CONSIDERED. ELECTRIC FAULTS OCCUR IN BOTH AC AND DC SYSTEMS. (PMA)
DESCRIPTORS	DIESEL ENGINES;ELECTRIC BATTERIES;ELECTRIC MOTORS;ELECTRIC RAILWAYS: T1;ELECTRICAL FAULTS;ENVIRONMENTAL IMPACTS;GAS TURBINES;POWER TRANSMISSION LINES;REVIEWS: Q1;TECHNOLOGY ASSESSMENT

D-73

ACCESSION NO.	78C0037803
TITLE	HYBRID PROPULSION SYSTEMS FOR ELECTRIC ROAD VEHICLES FOR SHORT RANGE PUBLIC PASSENGER TRANSPORT/TEST AND OPERATIONAL EXPERIENCE/PROSPECTS
AUTHORS	STRIFLER, P.
AUTHOR AFF	DAIMLER-BENZ AG, STUTTGART
TITLE(MONO)	FOURTH INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM. VOL. 1
PAGE NO	11P, PAPER 221.7
CONF TITLE	4. INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM
CONF PLACE	DUSSELDORF, F.R. GERMANY
CONF DATE	31 AUG 1976
PUBL LOC	ELECTRIC VEHICLE COUNCIL, NEW YORK
DATE	1976
LANGUAGE	IN GERMAN AND ENGLISH
DROP NOTE	SEE CONF-760866--P1
CATEGORIES	EDB-330300;250904
PRIMARY CAT	EDB-330300
AUGMENTATION	IN GERMAN AND ENGLISH
ABSTRACT	EXPERIENCE WITH TWO PART-ELECTRIC OR ALL-ELECTRIC HYBRID PROPULSION SYSTEMS IS DESCRIBED. THE HYBRID BUS OE 302/305 DERIVES ITS ENERGY FROM A LEAD BATTERY AND/OR A DIESEL-DRIVEN CHARGING UNIT. THE CHARGING ENGINE, BEING DESIGNED FOR A LOW AVERAGE POWER, CAN BE OPERATED AT VIRTUALLY CONSTANT SPEED WITHIN A FAVORABLE PART OF ITS CHARACTERISTIC AND CAN BE EFFECTIVELY ENCLOSED ACOUSTICALLY. CONSTANT POWER OUTPUT, IRRESPECTIVE OF THE LEVEL OF CHARGE OF THE BATTERY, WOULD HAVE REQUIRED THE MORE EXPENSIVE REGULATION SYSTEM. FOR SIMPLICITY, CONSTANT POWER WAS ABANDONED AND AN INCREASE IN THE 0 TO 50 KM/H ACCELERATION TIME FROM 13 TO 17 SECONDS AS THE BATTERY DISCHARGES WAS ACCEPTED. THE DUO-BUS IS BASED ON THE CONCEPT THAT IT IS BETTER TO LIMIT OPERATION WITH OVERHEAD CONDUCTORS TO THE MOST HEAVILY USED MAIN ROADS. IN THE VARIANT USING BATTERY OPERATION AWAY FROM THE OVERHEAD CONDUCTOR SYSTEM, A POWER SUPPLY UNIT IS USED TO FEED THE MOTOR AND BATTERY (360 V) FROM THE 600 V SYSTEM. BECAUSE OF THE HEAVY LOAD ON THE BATTERY DUE TO DISCHARGING AND CHARGING, IT IS NECESSARY TO HAVE AN ELECTROLYTE COOLER ON THE ROOF OF THE BUS. A SECOND PROPULSION SYSTEM WITHOUT BATTERY USES EITHER AN ELECTRIC MOTOR (FED FROM THE OVERHEAD CONDUCTOR SYSTEM) OR A DIESEL ENGINE. THE HYBRID PROPULSION SYSTEMS DESCRIBED ARE AT LEAST PARTLY (I.E., WHERE IT IS NECESSARY) EMISSION-FREE AND ELSEWHERE THEIR EMISSION IS LESS THAN THAT OF THE NORMAL DIESEL BUS. FUEL CONSUMPTION, IN TERMS OF PRIMARY ENERGY, IS HIGHER THAN THAT OF A DIESEL BUS BUT IT PERMITS A SMALLER RELIANCE ON PETROLEUM DERIVATIVES. OPERATING COSTS ARE AROUND 20% TO 40% HIGHER THAN FOR A DIESEL BUS ACCORDING TO THE TYPE OF PROPULSION SYSTEM AND THE MODE OF OPERATION. IN DECIDING ON THE USE OF THESE VEHICLES, THIS FACT MUST BE SET AGAINST THE ADVANTAGES.
DESCRIPTORS	COST;DEMONSTRATION PROGRAMS: Q1;DIESEL ENGINES;ELECTRIC MOTORS;

ELECTRIC-POWERED VEHICLES: M1;EXHAUST GASES;FUEL CONSUMPTION;
LEAD-ACID BATTERIES;OPERATION;PERFORMANCE TESTING;POWER
TRANSMISSION LINES

D-74

ACCESSION NO.	78J0037764
TITLE	VOLKSWAGEN DEVELOPS A DIESEL
PUB DESC	AUTOMOT. ENG. (N.Y.), V. 85, NO. 6, PP. 62-66
DATE	JUN 1977
CATEGORIES	EDB-330102
PRIMARY CAT	EDB-330102
ABSTRACT	VW'S DECISION TO PRODUCE A DIESEL COMES AFTER EXTENSIVE ANALYSES OF POWERPLANTS APPROPRIATE FOR THE NEXT TWO DECADES. THEIR STUDY CONSIDERED EVERYTHING FROM CONVENTIONAL ENGINES TO GAS TURBINES, ROTARIES, AND EVEN SEVERAL EXTERNAL-COMBUSTION CONFIGURATIONS. THE THREE COMMON APPROACHES--SPARK-IGNITED, DIESEL, AND STRATIFIED-CHARGE--WERE IDENTIFIED AS HAVING EVIDENT SUPERIORITY IN MASS PRODUCTION APPLICATIONS, AT LEAST UNTIL 1990. ALSO, BASED ON CONCEPT ACCEPTABILITY, FUNCTIONAL QUALITY, RESOURCE CONSERVATION, AND ENVIRONMENTAL ASPECTS, IT WAS CONCLUDED THAT THE DIESEL'S COMPETITIVE POSITION WOULD IMPROVE OVER THIS TIME FRAME.
DESCRIPTORS	AIR POLLUTION;AUTOMOBILES;COMBUSTION CHAMBERS;DESIGN;DIAGRAMS; DIESEL ENGINES: T1;FUEL ECONOMY;MACHINE PARTS;MANUFACTURING: Q1; NOISE POLLUTION;NOZZLES;PERFORMANCE;PUMPS;SERVICE LIFE;TORQUE

D-75

ACCESSION NO.	78J0032664
TITLE	CAN DIESEL SPECIFIC POWER BE INCREASED
PUB DESC	AUTOMOT. ENG. (N.Y.), V. 85, NO. 12, PP. 66-69
DATE	DEC 1977
CATEGORIES	EDB-330603;330102;330701;330704
PRIMARY CAT	EDB-330603
ABSTRACT	THREE METHODS OF INCREASING THE POWER CAPABILITY OF DIESEL ENGINES ARE INCREASED SPEED, INCREASED DISPLACEMENT, AND INCREASED SPECIFIC OUTPUT. THE ADVANTAGES AND DISADVANTAGES OF INCREASED SPECIFIC OUTPUT ARE DISCUSSED. ADVANTAGES INCLUDE MINIMUM ENGINE SIZE AND SPECIFIC WEIGHT CHANGE, REDUCED SPECIFIC FUEL CONSUMPTION, LOWER HEAT REJECTION, LOWER RELATIVE HYDROCARBON EMISSIONS, SMALL INCREASE IN MANUFACTURING COST, AND REDUCTION IN SERVICE PARTS PROLIFERATION. DISADVANTAGES INCLUDE INCREASED THERMAL AND MECHANICAL LOADING, LOW SPEED TORQUE LIMITATIONS, INCREASED NO/SUB X/ EMISSIONS, AND HIGHER NOISE LEVELS. (PMA)
DESCRIPTORS	AIR POLLUTION ABATEMENT;AUTOMOBILES: T1;COST;DESIGN: Q2;DIESEL ENGINES: T2,Q1;EXHAUST GASES: Q2;FUEL CONSUMPTION;HYDROCARBONS; MAINTENANCE;NITROGEN OXIDES;NOISE;SIZE;THERMAL EFFICIENCY; TORQUE;WEIGHT

D-76

ACCESSION NO.	78J0032656
TITLE	WHAT ARE THE FUEL ECONOMY POTENTIALS FOR EUROPEAN CARS: AND FOR DOMESTIC
PUB DESC	AUTOMOT. ENG. (N.Y.), V. 85, NO. 11, PP. 34-39
DATE	NOV 1977
CATEGORIES	EDB-330600
PRIMARY CAT	EDB-330600
ABSTRACT	A DISCUSSION IS GIVEN OF AUTOMOBILE DESIGN FACTORS INFLUENCING FUEL ECONOMY IN EUROPEAN AND U.S. CARS. SIMULATION BASED ON EMPIRICAL STUDIES OF EUROPEAN CARS WERE USED TO DETERMINE FUEL CONSUMPTION VALUES AND THE EFFECTS OF PARAMETER VARIATIONS. DYNAMOMETER TESTS OF SOME 1977 U.S. CARS ARE REPORTED, SHOWING THE ADDITIONAL FUEL CONSUMPTION RESULTING FROM EMISSION CONTROLS. ALSO DISCUSSED ARE: (1) ENGINE-TRANSMISSION MATCHING IMPROVEMENTS; (2) IMPROVED GASOLINE ENGINES; (3) DIESEL ENGINES; AND (4) STRATIFIED CHARGE ENGINES. (PMA)
DESCRIPTORS	AUTOMOBILES: T1;DESIGN: Q1;DIESEL ENGINES;DYNAMOMETERS;FUEL ECONOMY: Q1;MECHANICAL TRANSMISSIONS;POLLUTION CONTROL EQUIPMENT;SIMULATION;SPARK IGNITION ENGINES;STRATIFIED CHARGE ENGINES;TESTING;WEIGHT

D-77

ACCESSION NO.	78C0029934
REPORT NO.PAGE	CONF-531201 PP. 33-39

TITLE	DUAL FUEL DIESEL ENGINES
AUTHORS	FEICHTMANN, H.J.
TITLE(MONO)	FUEL AND POWER CONFERENCE
PAGE NO	33-39
CONF TITLE	FUEL AND POWER CONFERENCE
CONF PLACE	GRAND FORKS, ND, USA
CONF DATE	18 DEC 1953
DATE	1953
CATEGORIES	EDB-034000;200100
PRIMARY CAT	EDB-034000
REPORT NO	CONF-531201--
ABSTRACT	NONE
DESCRIPTORS	COST: Q3,Q4;DESIGN;DIESEL ENGINES: T2,Q1;DIESEL FUELS: T3,Q2; EFFICIENCY;NATURAL GAS: T4,Q2;OPERATION;PERFORMANCE: Q2; PIPELINES;POWER GENERATION;POWER PLANTS: T1

D-78

ACCESSION NO.	78J0028057
TITLE	ASYMPTOTIC COMBUSTION OF SPHERICAL DROPS
AUTHORS	YANG, W.J.
AUTHOR AFF	UNIV. OF MICHIGAN, ANN ARBOR
PUB DESC	LETT. HEAT MASS TRANSFER, V. 4, NO. 4, PP. 261-272
DATE	1977
CATEGORIES	EDB-400600
PRIMARY CAT	EDB-400600
ABSTRACT	AN ANALYSIS IS MADE TO DETERMINE THE RATES OF DROP SHRINKAGE AND FLAME MOVEMENT DURING THE ASYMPTOTIC COMBUSTION OF SPHERICAL DROPS CONTROLLED BY THE TRANSPORT OF HEAT AND MASS. THE EFFECTS OF UNSTEADY DIFFUSION AND RADIAL CONVECTION OF HEAT AND MASS ARE TAKEN INTO ACCOUNT. EXACT SOLUTIONS OF THE EQUATIONS GOVERNING SPHERICALLY-SYMMETRIC TRANSPORT PHENOMENA ARE OBTAINED FROM WHICH THE EXPRESSIONS DESCRIBING THE RADIUS TIME HISTORY FOR THE DROP AND FLAME SURFACE ARE DETERMINED. THE EFFECTS OF GAS INERTIA, TRANSIENT TERMS, AND RADIAL CONVECTION RESULTING FROM UNEQUAL FLUID DENSITIES ARE ESTABLISHED AND THE REGIONS OF APPLICABILITY OF PREVIOUSLY REPORTED APPROXIMATE SOLUTIONS ARE DETERMINED.
DESCRIPTORS	AEROSOLS;BURNERS;COMBUSTION KINETICS: Q1;CONVECTION;DENSITY; DIESEL ENGINES;DROPLETS;FUEL SOLUTIONS;FUELS;GAS TURBINES;HEAT TRANSFER;LIQUID FUELS: T1;MASS;MOTION;ROCKET ENGINES;SIZE; VOLUME

D-79

ACCESSION NO.	78J0027435
TITLE	ENGINEERING HIGHLIGHTS OF 1978 AUTOMOBILES
PUB DESC	AUTOMOT. ENG. (N.Y.), V. 85, NO. 10, PP. 35-42
DATE	OCT 1977
CATEGORIES	EDB-330600
PRIMARY CAT	EDB-330600
ABSTRACT	CAFE, CORPORATE AVERAGE FUEL ECONOMY, PROVIDES A FOCUS FOR VIEWING 1978'S OFFERING OF DOMESTIC AUTOMOBILES. FEDERAL LEGISLATION, OF COURSE, REQUIRES THAT SALES-WEIGHTED FUEL-ECONOMY AVERAGES HIT NO LESS THAN 18 MPG THIS COMING YEAR, AND AUTOMAKERS ARE COMMITTING EXTENSIVE DEVELOPMENT EFFORTS TO MEET CAFE STANDARDS THROUGH 1985'S FORMIDABLE 27.5 MPG. THIS STRIVING FOR BETTER FUEL ECONOMY MANIFESTS ITSELF IN WEIGHT REDUCTION, AERODYNAMIC IMPROVEMENT, VEHICLE RESIZING, AND CAREFULLY MATCHED DRIVETRAINS. BOTH INNOVATION AND REFINEMENT ARE EVIDENT AMONG 1978'S ENGINEERING HIGHLIGHTS. INNOVATIONS INCLUDE THE FIRST DOMESTICALLY-PRODUCED DIESEL FOR PASSENGER CAR USE AND A TURBOCHARGED V-6, THE LATTER PERCEIVED AS A POSSIBLE ALTERNATIVE TO THIS COUNTRY'S POPULAR V-8. REFINEMENTS INCLUDE MORE PLASTICS, ALUMINUM, AND HSLA STEELS FOR WEIGHT REDUCTION, A POSITIVE LOCKUP TORQUE CONVERTER FOR MORE EFFICIENT AUTOMATIC TRANSMISSIONS, AND INCREASING ELECTRONIC CONTROL OF ENGINE FUNCTIONS, INCLUDING TWO NEW ADOPTIONS OF THREE-WAY CATALYTIC CONVERSION.
DESCRIPTORS	AERODYNAMICS;AUTOMOBILES: T1;CATALYTIC CONVERTERS;DESIGN: Q1; DIESEL ENGINES;ELECTRIC CONTROLLERS;FUEL ECONOMY;MATERIALS; MECHANICAL TRANSMISSIONS;SIZE;SUPERCHARGERS;WEIGHT

D-80

ACCESSION NO.	78C0021566
TITLE(MONO)	NEW LOOK AT MULTIGRADED DIESEL ENGINE OILS

TITLE(SERIAL) SAE PAPER 760558
EDITOR OR COMP SMITH, M.F. JR.; TUNKEL, N.; BACHMAN, M.E.; FERNANDEZ, W.J.
SEC REPT NO CONF-760678--22
PAGE NO 14
CONF TITLE MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS ON COMBINED FUELS AND POWERPLANT
CONF PLACE ST. LOUIS, MO, USA
CONF DATE 8 JUN 1976
PUBL LOC SOCIETY OF AUTOMOTIVE ENGINEERS, WARRENDALE, PA
DATE 1976
CATEGORIES EDB-330600;330102
PRIMARY CAT EDB-330600
ABSTRACT BENEFITS FOR MULTIGRADED OILS DEVELOPED FOR DIESEL ENGINE SERVICE WERE FOUND IN PERFORMANCE AREAS SUCH AS LOW TEMPERATURE ENGINE CRANKING/STARTING, OIL CONSUMPTION RATE, BEARING WEAR, AND FUEL ECONOMY IN STOP-AND-GO SERVICE. STUDIES CONTINUE TO INDICATE THAT MULTIGRADED DIESEL ENGINE OILS SHOULD BE FORMULATED WITH A MINIMUM AMOUNT OF PURE POLYMER, CONSISTENT WITH DESIRED VISCOMETRIC TARGETS, IN ORDER TO MINIMIZE PISTON DEPOSIT FORMATION. PREMIUM MULTIGRADED, EXTENDED DRAIN LUBRICANTS DEPEND UPON MODERN VISCOSITY IMPROVER TECHNOLOGY COUPLED WITH IMPROVED DETERGENT-INHIBITOR ADDITIVE TECHNOLOGY.
DESCRIPTORS ADDITIVES;BEARINGS;DEPOSITS;DIESEL ENGINES: T2,01;FUEL ECONOMY; LUBRICATING OILS: Q2;PERFORMANCE TESTING;POLYMERS;START-UP; TRUCKS: T1;VISCOSITY;WEAR

D-81 ACCESSION NO. 78J0009116
TITLE POWER UNITS FOR THE FUTURE: GASOLINE OR DIESEL
AUTHORS GARRETT, K.
PUB DESC AUTOMOT. ENG. (LONDON), V. 2, NO. 3, PP. 58-59
DATE 1977
CATEGORIES EDB-330102
PRIMARY CAT EDB-330102
ABSTRACT A BRIEF REPORT IS GIVEN OF A RECENT CONFERENCE WHERE SOME WIDELY VARIED VIEWS WERE EXPRESSED ON THE DIESEL ENGINE AND ITS PERFORMANCE IN PRIVATE CARS. TOPICS DISCUSSED INCLUDE ENGINE COST, EXHAUST GASES, NOISE, DRIVEABILITY, AND FUEL CONSUMPTION. RESEARCH PROGRAMS AT PEUGEOT, ALFA ROMEO, AND SHELL INTERNATIONAL ARE DESCRIBED. (PMA)
DESCRIPTORS AUTOMOBILES: T1;COST;DIESEL ENGINES: T2,01;EXHAUST GASES;FUEL CONSUMPTION;NOISE;PERFORMANCE;RESEARCH PROGRAMS;TECHNOLOGY ASSESSMENT: Q2

D-82 ACCESSION NO. 78J0009115
TITLE REGENERATIVE ENGINE-TEST BRAKES CUT COSTS AND INCREASE EFFICIENCY
PUB DESC AUTOMOT. ENG. (LONDON), V. 2, NO. 3, PP. 19, 45
DATE 1977
CATEGORIES EDB-330102;330603
PRIMARY CAT EDB-330102
ABSTRACT A PROGRAM TO TEST DC REGENERATIVE ELECTRICAL BRAKES FOR AUTOMOTIVE DIESEL ENGINES IS DESCRIBED. A DISCUSSION IS GIVEN OF THE TEST FACILITIES TO BE USED AND THE ECONOMICS AND OPERATIONAL ADVANTAGES OF THE SYSTEM. (PMA)
DESCRIPTORS AUTOMOBILES: T1;COST;DIESEL ENGINES: T2,01;ECONOMICS;EFFICIENCY; OPERATION;REGENERATIVE BRAKING: Q2;TEST FACILITIES

D-83 ACCESSION NO. 78R0009104
TITLE(MONO) ENERGY USE AND OTHER COMPARISONS BETWEEN DIESEL AND GASOLINE TRUCKS. FINAL REPORT OCTOBER 1975--JUNE 1976
EDITOR OR COMP JACOBS, K.M.
CORPORATE AUTH MAINE DEPT. OF TRANSPORTATION, BANGOR (USA). MATERIALS AND RESEARCH DIV.
PAGE NO 135
AVAILABILITY NTIS PC A07/MF A01.
CONTRACT NO CONTRACT DOT-TSC-1042
DATE FEB 1977
CATEGORIES EDB-330101;330102;320203
PRIMARY CAT EDB-330101
REPORT NO PB--266036
ABSTRACT THIS REPORT PRESENTS FUEL CONSUMPTION AND OTHER DATA ON COMPARABLE DIESEL AND GASOLINE TRUCKS. THE DATA WAS COMPILED FROM ACTUAL, OPERATIONAL RECORDS OF THE MAINE DEPARTMENT OF TRANSPORTATION FOR TRUCKS OF ABOUT 24,000 POUNDS GROSS VEHICLE WEIGHT AND 150 TO 180 HORSEPOWER. INFORMATION ON THE USE OF OTHER PETROLEUM BASED PRODUCTS SUCH AS ENGINE OIL AND LUBES IS ALSO GIVEN, TOGETHER WITH INITIAL MAINTENANCE COSTS.
DESCRIPTORS COMPARATIVE EVALUATIONS;COST;DIESEL ENGINES: T3,01;FUEL CONSUMPTION: Q2,Q3;LUBRICATING OILS;MAINTENANCE;POWER;SPARK IGNITION ENGINES: T2,01;TRUCKS: T1;WEIGHT

D.85 "Angelo-Belgium DZ Range" Diesel Engine. Vol. 74, No. 796, pp. 5-9.

D.86 "Diesel Bus Performance Simulation Program", G. Larson and H. Zuckerber. P.B. 295524.

D.87 "Transportation Energy Conservation: An Environmental Overview", J.J. Bernard III, Conf. 781109-16, Nov. 1978.

D.88 "Adiabatic Turbocompound Engine Performance Prediction", R. Kamr, W. Bryzik, Society of Automotive Engineers, Paper #780068 1978.

D.89 "Soot Reduction in Diesel Engines: A Chemical Approach", J. Gaffney, R. Sapienza, T. Butcher, C. Krishnar, W. Marlow and T. O'Hare. Combustion Science and Technology Vol. 24. pp. 89-92, 1980.

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D.91 Private communication with Filex Seldon of Detroit Diesel Allison, January 1981.

D.92 Literature provided by V.E. Varno of Alco Power Inc.

D.93 Private communication with William B. Roberston of General Electric Co. in Erie, Pennsylvania.

D.94 "Diesel and Gas Turbine Worldwide Catalog", Vol. 45, 1980 edition. Some data provided by manufacturers.

D.95 Private communication with G.A. Hollins of Allis Chalmers, Harvey, Illinois, February 1980.

D.96 Private communication with B.K. Volz, Caterpillar Tractor Co., Peoria, February 1980.

STIRLING ENERGY CONVERSION SYSTEMS

Analysis

There are two engine types: 1) free piston and 2) kinematic. The earliest commercialization date is 1990 for either engine type. The largest free piston system is less than 100 kW and the largest kinematic system is 3000 kW. The input data for analysis of the Stirling system parameters are summarized in Table 13.

The following relationships were determined:

Stirling Engine Acquisition Cost Except Balance of Plant (SACX)

SACX = \$250/kW

Range = \$50/kW

Stirling Energy Conversion System Cost (SACS)

SACS = \$1100/kW

Stirling Energy Conversion System Operating and Maintenance Cost (SOM)

SOMI = \$110/kW/yr $\leq$ 1000 kW

SOMII = \$55/kW/yr > 1000 kW

Stirling Engine Efficiency Except Balance of Plant (SEFFX)

SEFFX = 43.8%

No dependence on capacity.

Stirling Energy Conversion System Efficiency (SEFF)

SEFF = 35.0%

No dependence on capacity.

Stirling Energy Conversion System Lifetime (SLIFE)

SLIFE = 20 years

Mean time between overhauls is 10,000 hours

Stirling Energy Conversion System Start-up Time (SSTAR)

SSTAR = 0.25 minute

Based on best Judgement

Table 13. DATA USED IN ANALYSIS FOR DIFFERENT PARAMETERS OF THE STIRLING ENERGY CONVERSION SYSTEM

Power System size, kW	Acquistion Cost Except ($/kW)	Volume Except B.O.P. (ft^3/kW)	System Acquisition Cost ($/kW)	Operation and Maintenance Cost (Percent of System Acquisition Cost)	Efficiency except B.O.P. (%)	System Efficiency (%)	Lifetime (Years)	Weight except B.O.P. (lb/kW)
1.5			1100	10.0			20	
5.0		0.96	1100	10.0			20	35.5, 41.7
10.0						30.0		
20.0		0.29	1100	10.0	43.5	35.0	20	18.2
27.0	200.0, 100.0				38.0	31.0, 33.0		
30.0			1100	10.0			20	
40.0					49.0	40.0		
45.0						33.0		
60.0		0.28	1100	10.0		34.0	20	
62.0						40.0		
100.0		1100	10.0		30.0,35.0	20		
250.0		0.27,0.41	1100	10.0	45.0,40.0	34.0,36.0, 30.0,35.0	20	16.8,17,17.7,24.5
500.0		0.27,0.41	1100	10.0	45.0,40.0	34.0,36.0, 30.0,35.0, 33.0	20	16.8,17,17.7,24.5
750.0		0.27,0.41	1100	10.0	45.0,40.0	34.0,36.0, 33.0	20	16.8,17,17.7,24.5
1000.0		0.27,0.41	1100	10.0	45.0,40.0	34.0,36.0, 36.0,33.0		16.6,16.8,17
1470.0		0.27,0.41			42.0			21.8,17.7,24.5
2206.0					45.0,40.0	34.0,36.0		16.6,16.8,17
5000.0			1100	5.0			20	

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Stirling Energy Conversion System Shut-down Time (SSHUT)

SSHUT = 8.33E-02 minutes

Based on best judgement of time to bring shaft to zero RPM.

Stirling Engine Volume Except Balance of Plant (SEV)

SEVI = 0.96 $ft^3/kW \leq 10$ kW

SEVII = 0.31 $ft^3/kW > 10$ kW

Stirling Energy Conversion System Volume (SSV)

SSV = 54.88636077 $X^{0.559709721}$ (ft^3)

x = kW

Stirling Engine Area Except Balance of Plant (SEA)

SEA = 0.257901952 $X^{0.66859887}$ (ft^2)

x = kW

Stirling Energy Conversion System Area (SSA)

SSA = 21.67186583 $X^{0.356912292}$ (ft^2)

x = kW

Stirling Engine Weight Except Balance of Plant (SEWT)

SEWTA = 38.6 lb/kW $\leq$ 5 kW

SEWTB = 18.4 lb/kW > 5 kW

Stirling Energy Conversion System Weight (SSWT)

SSWT = 0.903041797 $X^{1.323376905E03}$ (lb)

where x = kW

Type

Mobile $\leq$ 100 kW

Transpo 250 $\leq$ capacity $\leq$ 1000 kW

Fixed @ capacity = 5000 kW

Growth Potential

Stirling Energy Conversion Systems are non-codular

Raw Materials

Ordinal rating is 5.

Operation and Maintenance

Ordinal rating is 5.

Reliability

The ordinal rating for free piston and kinematic engines is 4. See Table 14.

Environmental Constraints

The ordinal rating is 5. See Table 15.

Location Constraints

The ordinal rating is 4. See Table 16.

Operational Constraints

The ordinal rating is 5. See Table 17.

Thermal Energy Available

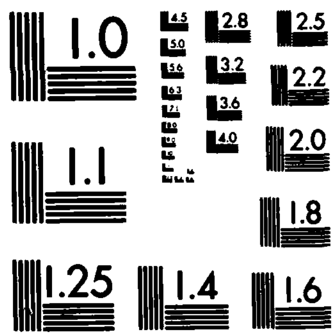
Ordinal rating is 2

Table 14. STIRLING ENGINE ENERGY CONVERSION SYSTEM RELIABILITY

Constraint	Effect	Remarks
1. Moving Parts	●	
2. Operating Temperature	0	
3. Modularity of the Design	0	
4. Stress Levels	0	
5. Corrosion	--	
6. Other	--	

Overall Assessment: The ordinal score is 4 indicating moderate reliability.

AD-A133 514   USAF ADVANCED TERRESTRIAL ENERGY STUDY VOLUME 4   3/8
ANALYSIS DATA AND BIBLIOG..(U) INSTITUTE OF GAS
TECHNOLOGY CHICAGO ILL E J DANIELS ET AL. APR 83 61045
UNCLASSIFIED   AFWAL-TR-82-2019-VOL-4 F33615-80-C-2041   F/G 10/1   NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table 15. STIRLING ENGINE ENERGY CONVERSION SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	0	0	0	Limited to Vicinity. Maybe air or water cooled
• Air Pollution				
CO	0	0	0	
NO_x	0	0	0	
SO_x	0	0	0	
HC	0	0	0	
Particulates	0	0	0	
Others	--	--	--	
• Noise	--	--	--	
• Odor	--	--	--	
• Solid Waste	--	--	--	
• Chemical Waste	--	--	--	

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraints.

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Table 16. STIRLING ENGINE ENERGY CONVERSION SYSTEM LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirement	---	Small amount for water-cooled engines
2. Manning Requirements	---	Minimal attention and normal inspection procedures are adequate
3. Fuel Availability and Delivery	●	Fuel delivery may be a problem due to poor weather or poor road conditions
4. Fuel Storage	●	
5. Other	---	

Overall Assessment: The ordinal score is 4 indicating moderate locational constraints.

Table 17. STIRLING ENGINE ENERGY CONVERSION SYSTEM OPERATIONAL CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability	--	
2. Overload Capability	0	
3. Load Following Capability	--	

Overall Assessment: The ordinal score is 5 indicating excellent turn-down capability; minor efficiency penalty.

STIRLING ENERGY CONVERSION SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Stirling Engine-Kinematic

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 19		33	45	3600rpm, $30^{\circ}C/820^{\circ}C$, metal
S. 19	40		62	3600rpm, $30^{\circ}C/1120^{\circ}C$, ceramic
S. 21	33		30	2500rpm, hydrogen
S. 22	45		500-2000hp	DOE programs
S. 3	40 (33 net electric)		500-3000hp	GE-DOE funded, for demonstration in 1985
S. 15	45 (goal)		∿ 1000	6.8 years development from the time of demonstration
S. 20	30-35%			

DATA SHEET

Energy Conversion System: Stirling Engines-Kinematic

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 21	variable		variable	GE and others

DATA SHEET

Energy Conversion System: Stirling Engines-Kinematic

Parameter: Weight

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 19		4.3kg/kw	45	Metalic design
S. 21	variable		variable	GE and others
S. 3	9.4lb/hp-12.5lb/hp		500-3000hp	GE, 1980

DATA SHEET

Energy Conversion System: Stirling Engines-Kinematic

Parameter: Start-up/Shut-down Time

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 21	good response			

DATA SHEET

Energy Conversion System: Stirling Engines-Kinematic

Parameter: O & M Cost (1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 20	5% of capital cost (> \$2 million)			
	10% of capital cost (< \$1 million)			

DATA SHEET

Energy Conversion System: Stirling Engines-Kinematic

Parameter: Acquisition Cost (1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 22	$500-550/kW (installed)		500-2000hp	DOE programs
S. 3	$308/kW - 398 kw		500-3000hp	GE, 1980
S. 15				
S. 20	Twice that of diesel			

DATA SHEET

Energy Conversion System: Stirling Engine-Kinematic

Parameter: Life-Time (Hrs)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 3	10,000 between overhaul		500-3000hp	
S. 15				

DATA SHEET

Energy Conversion System: Stirling Engines-Kinematic

Parameter: Operational Constraints

Constraint	Energy Conversion Systems Reference: Studies	Energy Conversion Systems Reference: Operating Plants
Environmental		
Thermal Discharge		
Air Pollution	S. 21	S. 19
Noise	S. 21	S. 19
Solid Waste	S. 21	
Chemical Waste	S. 21	
Location		
Water Requirements		
Manning Requirements		
Fuel Delivery		
Solar Insolation		
Wind Requirement		
Metropolitan Siting		
Electrical Power Requirement		
Operational		
Part Load Efficiency	S. 21	S. 19
Part Load Capability	S. 21	
Solar, Wind Dependence		
Overload Capacity		
Load Following	S. 21	
Life Dependence on Cycling		

DATA SHEET

Energy Conversion System: Stirling Engine-Free Piston

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 21	No specific data given			
S. 6	60% (goal)		15kW (10-100)	ERG, Solar Linear Gen. Ceramic Engine
S. 7	35%		15kW	MTI, Solar Linear Gen. Gas Bearings

DATA SHEET

Energy Conversion System: Stirling Engine-Free Piston

Parameter: Acquistion Cost (1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
S. 6	$60/kW		10-100	ERG, Ceramic Engine

STIRLING ENERGY CONVERSION SYSTEMS

Bibliography

S-1

ACCESSION NO.	80U0078973
REPORT NO.PAGE	DOE/JPL--1060-33 PP. 113-117
TITLE	UNITED STIRLING P40 ENGINE FOR SOLAR DISH CONCENTRATOR APPLICATION
AUTHORS	ORTEGREN, L.G. ; SJOSTEDT, L.E.
AUTHOR AFF	UNITED STIRLING, INC., ALEXANDRIA, VA
TITLE(MONO)	PROCEEDINGS OF THE FIRST SEMI-ANNUAL DISTRIBUTED RECEIVER SYSTEMS PROGRAM REVIEW
PAGE NO	113-117
AVAILABILITY	NTIS, PC A12/MF A01.
DATE	15 APR 1980
CATEGORIES	EDB-425003;140703
PRIMARY CAT	EDB-425003
REPORT NO	DOE/JPL--1060-33
ABSTRACT	THE UNITED STIRLING P40 ENGINE IS A KEY COMPONENT IN A SOLAR CONCENTRATOR BASED ENERGY CONVERSION SYSTEM, TO BE DEMONSTRATED AND TESTED DURING 1980-1981. THIS PAPER REVIEWS THE INHERENT CHARACTERISTICS OF MODERN STIRLING ENGINES AND FOCUSES ON THE BASELINE P40 DOUBLE-ACTING ENGINE. THIS FOUR CYLINDER ENGINE IS THE RESULT OF EXTENSIVE COMPONENT DEVELOPMENT WORK AT UNITED STIRLING IN SWEDEN, AND IS ALSO PLAYING KEY ROLES IN OTHER APPLICATION PROGRAMS, NOTABLY THE DOE/NASA AUTOMOTIVE STIRLING ENGINE PROGRAM. THE EXTENT OF MODIFICATIONS REQUIRED FOR THE SOLAR APPLICATION IS REVIEWED AND PERFORMANCE DATA ARE PREDICTED. FINALLY, THE POTENTIAL OF AN ADVANCED SOLAR STIRLING ENGINE IS BRIEFLY DEALT WITH.
DESCRIPTORS	DISTRIBUTED COLLECTOR POWER PLANTS: T2;PARABOLIC DISH COLLECTORS;PERFORMANCE;RESEARCH PROGRAMS: Q1;STIRLING ENGINES: T1,Q2;SWEDEN

S-2

ACCESSION NO.	80U0076465
REPORT NO.PAGE	DOE/JPL--1060-33 PP. 153-158
TITLE	COST ESTIMATING BRAYTON AND STIRLING ENGINES
AUTHORS	FORTGANG, H.R.
TITLE(MONO)	PROCEEDINGS OF THE FIRST SEMI-ANNUAL DISTRIBUTED RECEIVER SYSTEMS PROGRAM REVIEW
PAGE NO	153-158
AVAILABILITY	NTIS, PC A12/MF A01.
DATE	15 APR 1980
CATEGORIES	EDB-140700
PRIMARY CAT	EDB-140700
REPORT NO	DOE/JPL--1060-33
ABSTRACT	BRAYTON AND STIRLING ENGINES WERE ANALYZED FOR COST AND SELLING PRICE FOR PRODUCTION QUANTITIES RANGING FROM 1000 TO 400,000 UNITS PER YEAR. PARTS AND COMPONENTS WERE SUBJECTED TO INDEPTH SCRUTINY TO DETERMINE OPTIMUM MANUFACTURING PROCESSES COUPLED WITH MAKE OR BUY DECISIONS ON MATERIALS AND SMALL PARTS. TOOLING AND CAPITAL EQUIPMENT COSTS WERE ESTIMATED FOR EACH DETAIL AND/OR ASSEMBLY. FOR LOW ANNUAL PRODUCTION VOLUMES, THE BRAYTON ENGINE APPEARS TO HAVE A LOWER COST AND SELLING PRICE THAN THE STIRLING ENGINE. AS ANNUAL PRODUCTION QUANTITIES INCREASE, THE STIRLING BECOMES A LOWER COST ENGINE THAN THE BRAYTON. BOTH ENGINES COULD BENEFIT - COST WISE - IF CHANGES WERE MADE IN MATERIALS, DESIGN AND MANUFACTURING PROCESS AS ANNUAL PRODUCTION QUANTITIES INCREASE.
DESCRIPTORS	BRAYTON CYCLE;BRAYTON CYCLE POWER SYSTEMS: T3,Q1;CAPITAL;COST: Q2,Q3;MANUFACTURING;MATERIALS;PRICES;PRODUCTION;SOLAR THERMAL POWER PLANTS: T1;STIRLING ENGINES: T2,Q1

S-3

ACCESSION NO.	80R0065457
TITLE(MONO)	DESIGN AND DEVELOPMENT OF STIRLING ENGINES FOR STATIONARY POWER GENERATION APPLICATIONS IN THE 500 TO 3000 HP RANGE. SUBTASK IA REPORT: STATE-OF-THE-ART CONCEPTUAL DESIGN
CORPORATE AUTH	GENERAL ELECTRIC CO., PHILADELPHIA, PA (USA). VALLEY FORGE SPACE CENTER
PAGE NO	362
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT AC02-79ET15209
DATE	1 MAR 1980
CATEGORIES	EDB-200102;200104;425003
PRIMARY CAT	EDB-200102
REPORT NO	DOE/ET/15209--T1
ABSTRACT	THE FIRST PORTION OF THE CONCEPTUAL DESIGN STUDY OF STIRLING ENGINES FOR STATIONARY POWER APPLICATION IN THE 500 TO 3000 HP RANGE WHICH WAS AIMED AT STATE-OF-THE-ART STATIONARY STIRLING ENGINES FOR A 1985 HARDWARE DEMONSTRATION IS SUMMARIZED. THE MAIN GOALS OF THIS EFFORT WERE TO OBTAIN RELIABLE COST DATA FOR A STATIONARY STIRLING ENGINE CAPABLE OF MEETING FUTURE NEEDS FOR TOTAL ENERGY/COGENERATION SYSEMS AND TO ESTABLISH A PRAGMATIC AND CONSERVATIVE BASE DESIGN FOR A FIRST GENERATION HARDWARE. STARTING WITH AN EXTENSIVE SCREENING EFFORT, 4 ENGINE TYPES, I.E., V-TYPE CRANK ENGINE, RADIAL ENGINE, SWASHPLATE ENGINE, AND RHOMBIC DRIVE ENGINE, AND 3 HEAT TRANSPORT SYSTEMS, I.E., HEAT PIPE, PRESSURIZED GAS HEAT TRANSPORT LOOP, AND DIRECT GAS FIRED SYSTEM, WERE SELECTED. AFTER A PRELIMINARY LAYOUT CYCLE, THE RHOMBIC DRIVE ENGINE WAS ELIMINATED DUE TO INTOLERABLE MAINTENANCE DIFFICULTIES ON THE PUSH ROD SEALS. V, RADIAL AND SWASHPLATE ENGINES WERE TAKEN THROUGH A DETAILED DESIGN/LAYOUT CYCLE, TO ESTABLISH ALL IMPORTANT DESIGN FEATURES AND RELIABLE ENGINE WEIGHTS. AFTER COMPARING ENGINE LAYOUTS AND ANALYZING QUALITATIVE AND QUANTITATIVE EVALUATION CRITERIA, THE V-CRANK ENGINE WAS CHOSEN AS THE CANDIDATE FOR A 1985 HARDWARE DEMONSTRATION.
DESCRIPTORS	CO-GENERATION: T3;COMPARATIVE EVALUATIONS;DESIGN;DUAL-PURPOSE POWER PLANTS;ECONOMIC ANALYSIS;GRAPHS: D;MAINTENANCE; PERFORMANCE: Q2,D;RESEARCH PROGRAMS: Q2;STIRLING ENGINES: T2,Q3,Q4,D;TABLES: D;TOTAL ENERGY SYSTEMS: T4

S-4

ACCESSION NO.	80R0061042
TITLE(MONO)	COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS): GENERAL ELECTRIC COMPANY FINAL REPORT. VOLUME I. SUMMARY REPORT
EDITOR OR COMP	GERLAUGH, H.E.; HALL, E.W.; BROWN, D.H.; PRIESTLEY, R.R.; KNIGHTLY, W.F.
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). CORPORATE RESEARCH AND DEVELOPMENT DEPT.
SEC REPT NO	NASA-CR--159765(VOL.I)
PAGE NO	155
AVAILABILITY	DEP. NTIS, PC A08/MF A01.
CONTRACT NO	CONTRACT EC-77-A-31-162
DATE	JAN 1980
CATEGORIES	EDB-200100;320204;290800
PRIMARY CAT	EDB-200100
REPORT NO	DOE/NASA/0031--80/1
ABSTRACT	LARGE SAVINGS CAN BE MADE IN INDUSTRY BY COGENERATING ELECTRIC POWER AND PROCESS HEAT IN SINGLE ENERGY CONVERSION SYSTEMS RATHER THAN SEPARATELY IN UTILITY PLANTS AND IN PROCESS BOILERS. THIS STUDY EXAMINES THE USE OF VARIOUS ADVANCED ENERGY CONVERSION SYSTEMS AND COMPARES THEM WITH EACH OTHER AND WITH CURRENT TECHNOLOGY SYSTEMS FOR THEIR SAVINGS IN FUEL ENERGY, COSTS, AND EMISSIONS IN INDIVIDUAL PLANTS AND ON A NATIONAL LEVEL. ABOUT FIFTY INDUSTRIAL PROCESSES FROM THE LARGEST ENERGY CONSUMING SECTORS WERE USED AS A BASIS FOR MATCHING A SIMILAR NUMBER OF ENERGY CONVERSION SYSTEMS THAT ARE CONSIDERED AS CANDIDATE WHICH CAN BE MADE AVAILABLE BY THE 1985 TO 2000 TIME PERIOD. THE SECTORS CONSIDERED INCLUDED FOOD, TEXTILES, LUMBER, PAPER, CHEMICALS, PETROLEUM, GLASS, AND PRIMARY METALS. THE ENERGY CONVERISON SYSTEMS INCLUDED STEAM AND GAS TURBINES, DIESELS, THERMIONICS, STIRLING, CLOSED-CYCLE AND STEAM INJECTED GAS TURBINES, AND FUEL CELLS. FUELS CONSIDERED WERE COAL, BOTH COAL AND PETROLEUM-BASED RESIDUAL AND DISTILLATE LIQUID FUELS, AND LOW BTU GAS OBTAINED THROUGH THE ON-SITE GASIFICATION OF COAL. AN ATTEMPT WAS MADE TO USE CONSISTENT ASSUMPTIONS AND A CONSISTENT SET OF GROUNDRULES SPECIFIED BY NASA FOR DETERMINING PERFORMANCE AND COST. ATMOSPHERIC AND PRESSURIZED FLUIDIZED BED STEAM TURBINE SYSTEMS ARE THE MOST ATTRACTIVE OF THE DIRECT COAL-FIRED SYSTEMS. OPEN-CYCLE GAS TURBINES WITH HEAT RECOVERY STEAM GENERATORS AND COMBINED-CYCLES WITH NO/SUB X/ EMISSION REDUCTION AND MODERATELY INCREASED FIRING TEMPERATURES ARE THE MOST ATTRACTIVE OF THE COAL-DERIVED LIQUID-FIRED SYSTEMS.
DESCRIPTORS	CO-GENERATION: T5,01,D;COAL;COMPARATIVE EVALUATIONS;DIESEL ENGINES;ECONOMIC ANALYSIS: D;ELECTRIC POWER;ENERGY CONSERVATION: 01,05,D;ENERGY CONVERSION;ENVIRONMENTAL EFFECTS: 05;FLUIDIZED-BED COMBUSTION;FUEL CELLS;GAS TURBINES;GRAPHS: D; INDUSTRIAL PLANTS: T1,D;NUMERICAL DATA: D;PROCESS HEAT;REVIEWS; STEAM TURBINES;STIRLING ENGINES;TABLES: D;TECHNOLOGY ASSESSMENT: 05;USA

S-5

ACCESSION NO.	80R0045095
TITLE(MONO)	OVERVIEW OF A STIRLING ENGINE TEST PROJECT
EDITOR OR COMP	SLABY, J.G.
CORPORATE AUTH	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO	NASA-TM--81442
PAGE NO	27
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EC-77-A-31-1040
DATE	1980
CATEGORIES	EDB-330201;425003
PRIMARY CAT	EDB-330201
REPORT NO	DOE/NASA/1040--80/12
ABSTRACT	THE LEWIS RESEARCH CENTER IS CONDUCTING TESTS ON THREE STIRLING ENGINES RANGING IN SIZE FROM 1.33 TO 53 HORESEPOWER (1 TO 40 KW) . THE RESULTS OF THESE TESTS ARE CONTRIBUTING TO THE DEVELOPMENT OF A BROAD BASE OF STIRLING ENGINE TECHNOLOGY. IN ADDITION, THE TESTS ARE DIRECTED TOWARD DEVELOPING ALTERNATIVE, BACKUP COMPONENT CONCEPTS TO IMPROVE ENGINE EFFICIENCY AND PERFORMANCE OR TO REDUCE COSTS. SOME OF THE ACTIVITIES INCLUDE INVESTIGATING ATTRACTIVE CONCEPTS AND MATERIALS FOR COOLER-REGENERATOR UNITS, INSTALLING A JET IMPINGEMENT DEVICE ON A STIRLING ENGINE TO DETERMINE ITS POTENTIAL FOR IMPROVED ENGINE PERFORMANCE, AND PRESENTING PERFORMANCE MAPS FOR INITIAL CHARACTERIZATION OF STIRLING ENGINES. SOME OF THE EXPERIMENTAL RESULTS TO DATE AND PREDICTIONS OF RESULTS OF TESTS THAT WILL BE CONDUCTED ON THESE STIRLING ENGINES ARE PRESENTED.
DESCRIPTORS	EFFICIENCY: D;EXPERIMENTAL DATA: D;FEASIBILITY STUDIES: 01; GRAPHS: D;MATERIALS;PERFORMANCE TESTING;REGENERATORS;RESEARCH PROGRAMS: 01;SPECIFICATIONS: D;STIRLING ENGINES: T1,D; TECHNOLOGY ASSESSMENT

S-6

ACCESSION NO.	80C0044109
REPORT NO,PAGE	SERI/TP--313-492 P. VP
TITLE	ADVANCED FREE-PISTON STIRLING ENGINE DRIVEN 15 KWE LINEAR ALTERNATOR PROGRAM
AUTHORS	BENSON, G.M.
AUTHOR AFF	ENERGY RESEARCH AND GENERATION, INC., OAKLAND, CA
TITLE(MONO)	ADVANCED SOLAR THERMAL TECHNOLOGY PROGRAM. MEETING ABSTRACTS
SEC REPT NO	CONF-791221--
PAGE NO	VP
AVAILABILITY	DEP. NTIS, PC A08/MF A01.
CONF TITLE	SEMIANNUAL CONFERENCE FOR ADVANCED SOLAR THERMAL TECHNOLOGY
CONF PLACE	PHOENIX, AZ, USA
CONF DATE	11 DEC 1979
DATE	1979
CATEGORIES	EDB-140700
PRIMARY CAT	EDB-140700
REPORT NO	SERI/TP--313-492
ABSTRACT	THE OBJECTIVES OF THIS PHASE OF THE PROGRAM ARE: (1) DESIGN AND ANALYZE CRITICAL COMPONENTS AND SUBASSEMBLIES, (2) ASSESS AND OPTIMIZE THE THERMODYNAMIC AND DYNAMIC PERFORMANCE THROUGH COMPUTER SIMULATION, AND (3) PERFORM A PRELIMINARY DESIGN OF A RESONANT FREE-PISTON STIRLING ENGINE (RFPSE) DRIVEN 15 KWE LINEAR ALTERNATOR. PARTICULAR EMPHASIS IS ON: (1) HEAT EXCHANGER MATRICES, GAS BEARINGS, NARROW-CLEARANCE SEALS, CONTROL AND STABILITY, MANUFACTURABILITY, RELIABILITY AND

PRODUCTION COST OF A SOLAR-ENERGIZED ELECTRIC POWER PLANT EMPLOYING NON-STRATEGIC MATERIALS. PROGRESS IS OUTLINED. (WMK)

DESCRIPTORS ALTERNATORS;CONTROL SYSTEMS;COST;DESIGN: Q2;GAS BEARINGS;HEAT EXCHANGERS;PISTONS;POWER RANGE 10-100 KW;PRODUCTION;RESEARCH PROGRAMS;SEALS;SOLAR THERMAL POWER PLANTS: T1;STIRLING ENGINES: T2,Q1

S-7

ACCESSION NO.	80C0044105
REPORT NO.PAGE	SERI/TP--313-492 PP. 79-84
TITLE	FREE-PISTON SOLAR STIRLING ENGINE-ALTERNATOR
AUTHORS	DOCHAT, G.R.
AUTHOR AFF	MECHANICAL TECHNOLOGY INC., LATHAM, NY
TITLE(MONO)	ADVANCED SOLAR THERMAL TECHNOLOGY PROGRAM. MEETING ABSTRACTS
SEC REPT NO	CONF-791221--
PAGE NO	79-84
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONF TITLE	SEMIANNUAL CONFERENCE FOR ADVANCED SOLAR THERMAL TECHNOLOGY
CONF PLACE	PHOENIX, AZ, USA
CONF DATE	11 DEC 1979
DATE	1979
CATEGORIES	EDB-140700;425003
PRIMARY CAT	EDB-140700
REPORT NO	SERI/TP--313-492
ABSTRACT	OVER THE PAST FEW YEARS, MTI HAS CONCENTRATED ON THE DEVELOPMENT OF FREE-PISTON STIRLING ENGINES. MTI IS COMMITTED TO PRODUCT COMMERCALIZATION OF FREE-PISTON STIRLING ENGINES IN THE POWER SIZE RANGES FROM 1 TO 25 KW. THE FREE-PISTON STIRLING ENGINE (FPSE) PRODUCT DEVELOPMENT PROGRAM IS INVESTIGATING A NUMBER OF POTENTIAL APPLICATIONS. FREE-PISTON STIRLING ENGINES ARE ATTRACTIVE BECAUSE OF THEIR HIGH SYSTEM EFFICIENCY AND POTENTIAL FOR LONG LIFE, INHERENT RELIABILITY, AND MAINTENANCE FREE CHARACTERISTICS. IT IS THESE CHARACTERISTICS WHICH MAKE THE FREE-PISTON ENGINE DRIVING A LINEAR ALTERNATOR DESIRABLE FOR SMALL, DISPERSED SOLAR THERMAL ELECTRIC POWER SYSTEMS. THE GENERAL CONCLUSIONS OF A RECENTLY COMPLETED STUDY WITH NASA/LEWIS FOR A CONCEPTUAL DESIGN OF A 15 KW FREE-PISTON SOLAR STIRLING ENGINE ARE REVIEWED, AND HOW THE REQUIRED TECHNOLOGY IDENTIFIED IN THAT STUDY IS PRESENTLY BEING ADDRESSED WITH HARDWARE TESTING IS DISCUSSED.
DESCRIPTORS	DESIGN;PISTONS;POWER RANGE 1-10 KW;POWER RANGE 10-100 KW; RESEARCH PROGRAMS: Q1;SOLAR THERMAL POWER PLANTS: T2;STIRLING ENGINES: T1,Q2;TESTING

S-8

ACCESSION NO.	79C0131233
REPORT NO.PAGE	CONF-781050 PP. 72-81
TITLE	COST ANALYSIS FOR BRAYTON AND STIRLING ENGINES
AUTHORS	HEFT, R.C.
AUTHOR AFF	JET PROPULSION LAB., PASADENA, CA
TITLE(MONO)	PROCEEDINGS OF HIGHWAY VEHICLE SYSTEMS. CONTRACTORS' COORDINATION MEETING: FIFTEENTH SUMMARY REPORT
PAGE NO	72-81
AVAILABILITY	DEP. NTIS, PC A25/MF A01.
CONF TITLE	HIGHWAY VEHICLE SYSTEMS CONTRACTORS' MEETING
CONF PLACE	DEARBORN, MI, USA
CONF DATE	17 OCT 1978
DATE	MAR 1979
CATEGORIES	EDB-330201;330103
PRIMARY CAT	EDB-330201
REPORT NO	CONF-781050--
ABSTRACT	THE ENGINES CHOSEN FOR THE COST ANALYSIS WERE THE METALLIC FREE TURBINE BRAYTON AND THE FOUR-CYLINDER DOUBLE-ACTING SWASHPLATE STIRLING. THEIR COSTS WERE ANALYZED IN REFERENCE TO THE UNIFORM CHARGE, NATURALLY ASPIRATED OTTO CYCLE ENGINE. EACH OF THESE FOUR ENGINES WAS EVALUATED FOR DESIGN HORSEPOWERS OF 100 HP AND 150 HP.
DESCRIPTORS	AUTOMOBILES: T1;BRAYTON CYCLE POWER SYSTEMS: T2,Q1;COST: Q2,Q3; STIRLING ENGINES: T3,Q1

S-9

ACCESSION NO.	79A0129459
TITLE(MONO)	THERMAL POWER SYSTEMS RESEARCH AND DEVELOPMENT PROJECT. ADVANCED TECHNOLOGY DEPARTMENT SEMI-ANNUAL PROGRESS REPORT, OCTOBER 1977-MARCH 1978
CORPORATE AUTH	JET PROPULSION LAB., PASADENA, CA (USA)
PAGE NO	233
AVAILABILITY	DEP. NTIS, PC A11/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1060-003
DATE	JUN 1978
CATEGORIES	EDB-140703;142000
PRIMARY CAT	EDB-140703
REPORT NO	DOE/JPL/1060--3
ABSTRACT	THE TASK UNDERTAKEN BY NASA/JPL FOR THE ADVANCED THERMAL TECHNOLOGY BRANCH IS TO DEVELOP ADVANCED TECHNOLOGY TO IMPROVE LIFE CYCLE COSTS OF SOLAR THERMAL ELECTRIC POWER PLANTS. AS A RESULT OF THE PLANNING AND SPECIAL STUDIES ACTIVITIES, A POINT-FOCUSING CONCENTRATOR, STIRLING ENGINE/ALTERNATOR SOLAR THERMAL ELECTRICITY POWER PLANT CONCEPT WAS IDENTIFIED AS THE MOST LIKELY COST-EFFECTIVE CANDIDATE SYSTEM TO BE DEVELOPED FOR

FUTURE DISPERSED SOLAR POWER APPLICATIONS. THE DISH-STIRLING ADVANCED TECHNOLOGY DEVELOPMENT TASK WAS INITIATED IN OCTOBER 1977 WITH THE GOAL OF DEMONSTRATING THE FEASIBILITY OF THE CONCEPT THROUGH A SINGLE PROTOTYPE MODULE TEST PROGRAM WITHIN 5 YEARS. GREATER THAN 25 PERCENT EFFICIENCY IN GENERATING ELECTRICITY WITH A MODULE DIRECT COST OF LESS THAN $700 (1975 DOLLARS) PER PEAK KILOWATT OF ELECTRICITY (KWE) AT THE GENERATOR IS THE 1983 OBJECTIVE. A SOMEWHAT LONGER-TERM GOAL IS TO REDUCE THE MODULE COST TO LESS THAN $500 PER PEAK KILOWATT OF ELECTRICITY AT THE GENERATOR. IN ADDITION, GOALS FOR EFFICIENCY AND COST FOR ELECTRIC. ENERGY TRANSPORT AND STORAGE WITHIN A PROJECTED 10 MWE RATED POWER PLANT WERE SET AS 96 PERCENT AND $63/KWE FOR TRANSPORT AND 87 PERCENT AND $37/KWE-HR FOR STORAGE AND INVERSION. OTHER GOALS FOR SUBSYSTEMS ARE 70 PERCENT EFFICIENCY FOR THE COLLECTOR (CONCENTRATOR AND RECEIVER) WITH A TOTAL COST OF THE COLLECTOR LESS THAN $100 PER SQUEARE METER OF CONCENTRATOR APERTURE. STATUS OF THE DESIGN STUDIES ON SOLAR CONCENTRATORS, SOLAR RECEIVERS, THERMAL-TO-ELECTRIC ENERGY CONVERSION, ENERGY TRANSPORT AND STORAGE, AND POWER PROCESSING IS REPORTED. (WHK)

DESCRIPTORS CONTROL SYSTEMS;DESIGN; Q1;DISTRIBUTED COLLECTOR POWER PLANTS; T1;ENERGY STORAGE;HEAT PIPES;HEAT TRANSFER;HEAT TRANSFER FLUIDS; LATENT HEAT STORAGE;LIFE-CYCLE COST;LIQUID METALS;MATERIALS; PARABOLIC DISH COLLECTORS;SENSIBLE HEAT STORAGE;SOLAR RECEIVERS; SOLAR TRACKING;STIRLING CYCLE;STIRLING ENGINES; Q1; THERMOCHEMICAL HEAT STORAGE

S-10 99/5/000014-0000036// 18
ACCESSION NO. /9H012V444
TITLE(MONO) HANDBOOK OF DATA ON SELECTED ENGINE COMPONENTS FOR SOLAR THERMAL APPLICATIONS
CORPORATE AUTH NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO NASA-TM--79027
PAGE NO 295
AVAILABILITY DEP. NTIS, PC A11/MF A01.
CONTRACT NO CONTRACT EX-76-A-29-1060
DATE JUN 1979
CATEGORIES EDB-140700;200102
PRIMARY CAT EDB-140700
REPORT NO DOE/NASA/1060--78/1
ABSTRACT A SURVEY OF DEVELOPED AND COMMERCIALLY AVAILABLE HEAT-ENGINE COMPONENTS APPLICABLE FOR SOLAR THERMAL POWER SYSTEMS WAS CONDUCTED. THE DATA WERE COMPILED, AND A HANDBOOK WAS PREPARED FOR THE DEPARTMENT OF ENERGY, DIVISION OF CENTRAL SOLAR TECHNOLOGY, BY THE NASA LEWIS RESEARCH CENTER. DESIGN, PERFORMANCE, AND COST DATA WERE PROVIDED BY THE RESPECTIVE MANUFACTURERS ON STEAM TURBINES, RECIPROCATING EXPANSION ENGINES, CONDENSERS, PUMPS, GAS TURBINES, SPEED REDUCERS, AND AC GENERATORS FOR USE IN RANKINE- AND BRAYTON-CYCLE POWER-GENERATING SYSTEMS. COMPONENTS WERE SELECTED FOR SPECIFIC POWER LEVELS FROM 5- TO 50,000-KWE SYSTEM OUTPUT. DEVELOPMENT STATUS OF THE STIRLING ENGINE IS INCLUDED. THE DATA PRESENTED IN THIS HANDBOOK IDENTIFY COMPONENT DESIGN RANGES AND PERFORMANCE CHARACTERISTICS AT SPECIFIC POWER LEVELS OF DEVELOPED AND COMMERCIALLY AVAILABLE COMPONENTS.
DESCRIPTORS ALTERNATING CURRENT;BRAYTON CYCLE;BRAYTON CYCLE POWER SYSTEMS; T3;CLOSED-CYCLE SYSTEMS;CONTROL SYSTEMS;COST;DATA;DESIGN; DIAGRAMS;EFFICIENCY;ELECTRIC GENERATORS;GAS COMPRESSORS;GAS TURBINES;MANUALS; Q1,Q2,Q3,Q4;MANUFACTURERS;OPEN-CYCLE SYSTEMS; PERFORMANCE;POWER SYSTEMS; Q5;PUMPS;RANKINE CYCLE;RANKINE CYCLE ENGINES; T2;RANKINE CYCLE POWER SYSTEMS;SOLAR HEAT ENGINES; T1; SOLAR THERMAL POWER PLANTS; T5;SPEED REGULATORS;STEAM TURBINES; STIRLING CYCLE;STIRLING ENGINES; T4;THERMODYNAMICS;VAPOR CONDENSERS

S-11 99/5/000014-0000036// 19
ACCESSION NO. /9H0099733
TITLE(MONO) ENERGY AND COST SAVINGS RESULTS FOR ADVANCED TECHNOLOGY SYSTEMS FROM THE COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS)
EDITOR OR COMP SAGERMAN, G.D.; BARNA, G.J.; BURNS, R.K.
CORPORATE AUTH NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO NASA-TM--79203

PAGE NO	23
AVAILABILITY	P 02/MF A01.
CONTRACT NO	CONTRACT EC-77-A-31-1062
DATE	1979
CATEGORIES	EDB-290800;320304;320301
PRIMARY CAT	EDB-290800
REPORT NO	DOE/NASA/1062--79/2
ABSTRACT	AN OVERVIEW OF THE ORGANIZATION AND METHODOLOGY AND A SUMMARY OF SELECTED RESULTS TO DATE OF THE COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS) ARE PRESENTED. THE OBJECTIVES OF THE STUDY ARE TO IDENTIFY THE MOST ATTRACTIVE ADVANCED ENERGY CONVERSION SYSTEMS FOR INDUSTRIAL COGENERATION APPLICATIONS IN THE 1985 TO 2000 TIME PERIOD AND TO ASSESS THE ADVANTAGES OF ADVANCED TECHNOLOGY SYSTEMS COMPARED TO THOSE SYSTEMS COMMERCIALLY AVAILABLE TODAY. ADVANCED SYSTEMS BEING STUDIED INCLUDE STEAM TURBINES, OPEN AND CLOSED CYCLE GAS TURBINES, COMBINED CYCLES, DIESEL ENGINES, STIRLING ENGINES, PHOSPHORIC ACID AND MOLTEN CARBONATE FUEL CELLS AND THERMIONICS. STEAM TURBINES, OPEN CYCLE GAS TURBINES, COMBINED CYCLES, AND DIESEL ENGINES ARE ALSO BEING ANALYZED IN VERSIONS TYPICAL OF TODAY'S COMMERCIALLY AVAILABLY TECHNOLOGY TO PROVIDE A BASE AGAINST WHICH TO MEASURE THE ADVANCED SYSTEMS. COGENERATION APPLICATIONS IN THE MAJOR ENERGY CONSUMING MANUFACTURING INDUSTRIES ARE BEING CONSIDERED. RESULTS OF THE STUDY IN TERMS OF PLANT LEVEL ENERGY SAVINGS, ANNUAL ENERGY COST SAVINGS AND ECONOMIC ATTRACTIVENESS ARE PRESENTED FOR THE VARIOUS ENERGY CONVERSION SYSTEMS CONSIDERED. SENSITIVITY OF THE RESULTS TO VARIATIONS IN ASSUMED STUDY GROUNDRULES SUCH AS FUEL PRICES AND THE PRICE OF PURCHASED ELECTRICITY AND THE POTENTIAL EFFECT OF REGIONAL CHARACTERISTICS ARE DISCUSSED.
DESCRIPTORS	CO-GENERATION: T2,U1,D;COAL;COMBINED-CYCLE POWER PLANTS;COST; DIESEL ENGINES;ECONOMIC ANALYSIS: U2,D;ELECTRIC POWER;ENERGY CONSERVATION: U1,D;ENERGY CONVERSION: U2;FUEL CELLS;FUEL OILS; GAS TURBINES;GRAPHS: D;HEAT RECOVERY;INDUSTRIAL PLANTS: T1; NATURAL GAS;NUMERICAL DATA: D;POWER GENERATION;STEAM TURBINES; STIRLING ENGINES;TECHNOLOGY ASSESSMENT: U2;THERMIONIC CONVERTERS

S-12 99/5/000014-0000036//   20

ACCESSION NO.	7930099119
TITLE	STIRLING ENGINE
AUTHORS	FALEY, J.
AUTHOR AFF	DEPT. OF ENERGY, WASHINGTON, DC
PUB DESC	PUBLIC POWER, V. 36, NO. 2, P. 42
DATE	MAR 1978
CATEGORIES	EDB-200102;425003
PRIMARY CAT	EDB-200102
ABSTRACT	ONE OF THE FEATURES OF STIRLING ENGINES CREATING INTEREST IN THEIR USE FOR POWER GENERATION IS THEIR ABILITY TO RUN ON LOW-GRADE ENERGY SOURCES. THE OPERATION AND APPLICATIONS OF STIRLING ENGINES ARE BRIEFLY DISCUSSED, AND SEVERAL RESEARCH PROGRAMS INVOLVING STIRLING ENGINES ARE DESCRIBED. (PMA)
DESCRIPTORS	ENERGY SOURCES;OPERATION;RESEARCH PROGRAMS;STIRLING ENGINES: T2,U1;THERMAL POWER PLANTS: T1;US DOE;USES: U2

S-13 99/5/000014-0000036//   21

ACCESSION NO.	7930099102
TITLE	ADVANCED TYPES OF GENERATION FOR SMALLER UTILITY SYSTEMS
AUTHORS	STEITZ, P.; MAYO, G.
AUTHOR AFF	BURNS AND MCDONNELL ENGINEERING CO., KANSAS CITY, MO
PUB DESC	PUBLIC POWER, V. 36, NO. 2, PP. 24-28
DATE	MAR 1978
CATEGORIES	EDB-200100;425000;300504
PRIMARY CAT	EDB-200100
ABSTRACT	A TECHNOLOGY ASSESSMENT AND ECONOMIC ANALYSIS ARE GIVEN ON THE USE OF SMALL MUNICIPAL AND OTHER PUBLICLY OWNED UTILITY SYSTEMS AND RURAL ELECTRIC COOPERATIVES. THE STUDY INDICATES THAT POWER SUPPLY COST REDUCTIONS CAN BE ACHIEVED BY SMALL UTILITIES IF THEY INSTALL THEIR OWN INTERMEDIATE-PEAKING RANGE CAPACITY. OF THE SEVERAL TYPES OF POWER GENERATION SYSTEMS CONSIDERED, THE FUEL CELL AND THE ORGANIC RANKINE BOTTOMING TECHNOLOGIES ARE MOST ADVANCED. (PMA)
DESCRIPTORS	BOTTOMING CYCLES;COMBINED CYCLES;COST;DIESEL ENGINES;ECONOMIC ANALYSIS;FUEL CELL POWER PLANTS;GAS TURBINES;RANKINE CYCLE

POWER SYSTEMS;SIZE: 01;STIRLING ENGINES;TECHNOLOGY ASSESSMENT: 01;THERMAL POWER PLANTS: T1

S-14	ACCESSION NO.	79X0098907
	TITLE(MONO)	ADVANCED SUBSYSTEMS DEVELOPMENT. SECOND SEMI-ANNUAL PROGRESS REPORT, APRIL 1--OCTOBER 1, 1978
	CORPORATE AUTH	JET PROPULSION LAB., PASADENA, CA (USA); NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
	SEC REPT NO	JPL-PUB--79-24
	PAGE NO	244
	AVAILABILITY	P 11/MF A01.
	CONTRACT NO	CONTRACT EX-76-A-29-1060
	DATE	15 NOV 1978
	CATEGORIES	EDB-140700
	PRIMARY CAT	EDB-140700
	REPORT NO	DOE/JPL/1060--6
	ABSTRACT	THE CONCEPT DESIGN FOR A SMALL (LESS THAN 10 MWE) SOLAR THERMAL ELECTRIC GENERATING PLANT WAS COMPLETED USING PROJECTED 1985 TECHNOLOGY. THE SYSTEMS REQUIREMENTS WERE DEFINED AND SPECIFIED. THE COMPONENTS, INCLUDING AN ENGINEERING PROTOTYPE FOR ONE 15 KWE MODULE OF THE GENERATING PLANT, WERE CONCEPTUALLY DESIGNED. SIGNIFICANT FEATURES OF THE SMALL SOLAR THERMAL POWER PLANT WERE IDENTIFIED AS THE FOLLOWING: (1) 15-KWE STIRLING-CYCLE ENGINE/ALTERNATOR WITH CONSTANT POWER OUTPUT; (2) 10-METER POINT-FOCUSING PARABOLOIDAL CONCENTRATOR WITH CANTILEVERED CELLULAR GLASS REFLECTING PANELS; (3) PRIMARY HEAT PIPE WITH 800550P OSC OUTPUT SOLAR CAVITY RECEIVER; (4) SECONDARY HEAT PIPE WITH MOLTEN SALT THERMAL ENERGY STORAGE UNIT; (5) ELECTRIC ENERGY TRANSPORT SYSTEM; AND (6) ADVANCED BATTERY ENERGY STORAGE CAPABILITY. THE PRESENT EMPHASIS FOR ACHIEVING COST REDUCTION GOALS CENTERS ON IMPROVING CONVERSION EFFICIENCY AND REDUCING THE COST OF KEY COMPONENTS.
	DESCRIPTORS	COATINGS;CONTROL SYSTEMS;COST;DESIGN: 01;ELECTRIC UTILITIES; EQUIPMENT INTERFACES;FABRICATION;HEAT EXCHANGERS;HEAT PIPES; HEAT TRANSFER;INTERCONNECTED POWER SYSTEMS;MOLTEN SALTS;OPTICS; PARABOLIC DISH COLLECTORS;PARABOLIC REFLECTORS;POWER RANGE 10-100 KW;POWER SYSTEMS;SENSIBLE HEAT STORAGE;SOLAR THERMAL POWER PLANTS: T1;SOLAR TRACKING;SPECIFICATIONS;STIRLING CYCLE: 01;STIRLING ENGINES;SYSTEMS ANALYSIS;THERMAL ENERGY STORAGE EQUIPMENT

S-15	ACCESSION NO.	79C0055301
	TITLE(MONO)	ON THE ROLE OF EXTERNAL COMBUSTION ENGINES FOR ON-SITE POWER GENERATION
	EDITOR OR COMP	HOLTZ, R.E.; OHERKA, K.L.
	CORPORATE AUTH	ARGONNE NATIONAL LAB., IL (USA)
	PAGE NO	11
	AVAILABILITY	DEP. NTIS, PC A02/MF A01.
	CONTRACT NO	CONTRACT W-31-109-ENG-38
	CONF TITLE	3. NATIONAL CONFERENCE AND EXHIBITION ON TECHNOLOGY FOR ENERGY CONSERVATION
	CONF PLACE	TUCSON, AZ, USA
	CONF DATE	22 JAN 1979
	DATE	1979
	CATEGORIES	EDB-290800;320304;320603
	PRIMARY CAT	EDB-290800
	REPORT NO	CONF-790107--4
	ABSTRACT	STATIONARY EXTERNAL COMBUSTION ENGINES ARE PRIME MOVERS THAT HAVE POTENTIAL FOR BECOMING VIABLE POWER GENERATION MACHINES IN BOTH THE RESIDENTIAL/COMMERCIAL AND INDUSTRIAL SECTORS. THESE LARGE ENGINES ARE BEING DEVELOPED WITH THE CAPABILITY TO EMPLOY ALTERNATIVE AND/OR NON-SCARCE FUELS. ENERGY SOURCES UNDER CONSIDERATION INCLUDE COAL, COAL DERIVED LIQUIDS AND GASES, LOW-GRADE PETROLEUM RESIDUES, BIOMASS, AND MUNICIPAL WASTES. ADVANTAGES OF EXTERNAL COMBUSTION ENGINES RELATIVE TO CONVENTIONAL PRIME MOVERS ARE: GREATER FUEL EFFICIENCY, REDUCED ENVIRONMENTAL IMPACTS (NOISE AND EMISSIONS), AND A HIGH DEGREE OF FUEL FLEXIBILITY. EXTERNAL COMBUSTION ENGINES INCLUDE STEAM TURBINES, STIRLING CYCLE ENGINES, AND EXTERNALLY-FIRED BRAYTON GAS TURBINES. AMONG THE VARIOUS APPLICATIONS FOR EXTERNAL COMBUSTION ENGINES ARE: TOTAL ENERGY PLANTS, ICES, INDUSTRIAL COGENERATION, SMALL MUNICIPAL GENERATING PLANTS, AND PUMPING STATIONS. IT IS NOT NECESSARY FOR ALL THE HEAT SUPPLIED AN EXTERNAL COMBUSTION ENGINE TO COME FROM A SINGLE SOURCE. VARIOUS NON-COAL SOURCES THAT CAN BE USED EITHER INDEPENDENTLY OR INTEGRATED WITH OTHERS TO SUPPLY HEAT TO EXTERNAL COMBUSTION ENGINES INCLUDE SOLAR ENERGY, MUNICIPAL WASTES, BIOMASS, AND GEOTHERMAL. STIRLING ENGINE BASED SYSTEMS ARE DESCRIBED. THE DEVELOPMENT OF THE STIRLING ENGINE IS BRIEFLY DISCUSSED. (MCW)
	DESCRIPTORS	BIOMASS;BRAYTON CYCLE POWER SYSTEMS: 13;CO-GENERATION;COAL GAS; COAL LIQUIDS;COMPARATIVE EVALUATIONS;COST;DESIGN;EFFICIENCY; ENVIRONMENTAL IMPACTS;EVALUATION: 01,02,03;GEOTHERMAL ENERGY; ICES;MUNICIPAL WASTES;POWER GENERATION: 01,02,03;SOLAR ENERGY; STEAM TURBINES: 11;STIRLING CYCLE;STIRLING ENGINES: 12;TOTAL ENERGY SYSTEMS;TURBINES

S-16

ACCESSION NO.	7600116367
TITLE(MONO)	SOME UNUSUAL ENGINES
EDITOR OR COMP	SETRIGHT, L.J.K.
PAGE NO	145
AVAILABILITY	$13.50
PUBL LOC	MECHANICAL ENGINEERING PUBLICATIONS LTD., LONDON
DATE	1975
ISBN CODE	ISBN 0-85298-208-4
CATEGORIES	EDB-330100;330201;330603
PRIMARY CAT	EDB-330100
DOCUMENTATION	BOOK
ABSTRACT	CURRENT CONCERNS FOR ENVIRONMENT AND FUEL ECONOMY HAVE RESULTED IN A RENEWED INTEREST IN UNCONVENTIONAL INTERNAL COMBUSTION ENGINES. THE HISTORICAL DEVELOPMENT OF UNORTHODOX ENGINES IS DELINEATED WITH RESPECT TO UNUSUAL RESPIRATION IN CHARGING AND SCAVENGING; UNUSUAL CONSTRUCTION; UNUSUAL VALVE APPARATUS; UNUSUAL FORMAT; AND UNUSUAL TRANSLATION OF POWER. A FINAL CHAPTER IS DEVOTED TO FUTURE PROSPECTS OF UNCONVENTIONAL ENGINE DESIGN. TOPICS DISCUSSED INCLUDE ROTARY ENGINES, STRATIFIED CHARGE ENGINES, DIESEL ENGINES, GAS TURBINES, AND STIRLING ENGINES. (PMA)
DESCRIPTORS	CONSTRUCTION;DESIGN: Q1;DIESEL ENGINES;FORECASTING;FUEL SYSTEMS; GAS TURBINES;INTERNAL COMBUSTION ENGINES: M1;MECHANICAL TRANSMISSIONS;REVIEWS;ROTARY ENGINES;STIRLING ENGINES; STRATIFIED CHARGE ENGINES;TECHNOLOGY ASSESSMENT: Q1;VALVES

S-17

ACCESSION NO.	78R0103016
TITLE(MONO)	STIRLING ENGINE DESIGN MANUAL
EDITOR OR COMP	MARTINI, W.R.
CORPORATE AUTH	WASHINGTON UNIV., RICHLAND (USA). JOINT CENTER FOR GRADUATE STUDY
SEC REPT NO	NASA-CR--135382
PAGE NO	370
AVAILABILITY	DEP. NTIS, PC A16/MF A01.
CONTRACT NO	CONTRACT EX-76-A-28-3152
DATE	APR 1978
CATEGORIES	EDB-330201;425003
PRIMARY CAT	EDB-330201
REPORT NO	DOE/NASA/3152--78/1
ABSTRACT	THE PURPOSE OF THE DESIGN MANUAL PRESENTED IS TO PROVIDE AN INTRODUCTION TO STIRLING CYCLE HEAT ENGINES, TO ORGANIZE AND IDENTIFY THE AVAILABLE STIRLING ENGINE LITERATURE, AND TO IDENTIFY, ORGANIZE, EVALUATE AND, IN SO FAR AS POSSIBLE, COMPARE NON PROPRIETARY STIRLING ENGINE DESIGN METHODOLOGIES. AS SUCH, THE MANUAL THEN REPRESENTS A FIRST STEP IN THE LONG PROCESS OF MAKING AVAILABLE COMPREHENSIVE, WELL VERIFIED, ECONOMIC-TO-USE, STIRLING ENGINE ANALYTIC PROGRAMS. THE BASIC PRINCIPLES OF HEAT ENGINES ARE EXPLAINED. A STIRLING ENGINE IS DEFINED AS A HEAT ENGINE THAT MOVES A BODY OF GAS AROUND IN SUCH A WAY AS TO COMPRESS THE GAS PRINCIPALLY IN THE COLD PART OF THE ENGINE AND EXPAND IT PRINCIPALLY IN THE HOT PART OF THE ENGINE. HEAT IS SUPPLIED AND REMOVED THROUGH THE WALLS OF THE ENGINE. IN INTRODUCING STIRLING ENGINES, THE VARIETY OF STIRLING ENGINE TYPES AND THEIR UTILITY IN COMPARISON TO OTHER MACHINES ARE DISCUSSED. USEFUL STIRLING ENGINES ARE OR CAN BE BUILT FROM AN OUTPUT OF A FEW WATTS TO A MEGAWATT. POWER DENSITY IS USUALLY AS HIGH AS A DIESEL ENGINE AND CAN APPROACH A GASOLINE AUTOMOBILE ENGINE. EFFICIENCIES 30 PERCENT HIGHER THAN AN AUTOMOBILE ENGINE ARE PROJECTED. THE THEORY OF STIRLING ENGINE IS PRESENTED STARTING FROM SIMPLE CYCLE ANALYSIS. IMPORTANT CONCLUSIONS FROM CYCLE ANALYSIS ARE: (1) COMPARED TO AN ENGINE WITH ZERO UNSWEPT GAS VOLUME (DEAD VOLUME), THE POWER AVAILABLE FROM AN ENGINE WITH DEAD VOLUME IS REDUCED PROPORTIONAL TO THE RATIO OF THE DEAD VOLUME TO THE MAXIMUM GAS VOLUME; AND (2) AT THE USUAL DEAD VOLUME RATIOS OF GREATER THAN 50 PERCENT USED IN STIRLING ENGINES THE ERROR IN COMPUTING THE WORK PER CYCLE USING THE EASY TO COMPUTE ISOTHERMAL SPACES INSTEAD OF THE MORE REALISTIC BUT MORE DIFFICULT TO COMPUTE ADIABATIC SPACES IS 1 TO 2 PERCENT. ENGINE DESIGN METHODS ARE ORGANIZED AS FIRST ORDER, SECOND ORDER AND THIRD ORDER WITH INCREASED ORDER NUMBER INDICATING INCREASED COMPLEXITY.
DESCRIPTORS	AUTOMOBILES: T2;COMPARATIVE EVALUATIONS;DESIGN: Q1;EFFICIENCY; ENERGY LOSSES;MANUALS;MATHEMATICAL MODELS;PERFORMANCE;REVIEWS; STIRLING ENGINES: T1,Q2;TECHNOLOGY ASSESSMENT;THERMODYNAMICS; USES

S-18

ACCESSION NO.	78R0069369
TITLE(MONO)	ASSESSMENT OF THE ROLE OF ADVANCED TECHNOLOGIES IN SMALL UTILITIES. FINAL REPORT
EDITOR OR COMP	STEITZ, P.; MAYO, G.
CORPORATE AUTH	BURNS AND MCDONNELL ENGINEERING CO., KANSAS CITY, MO. (USA)
PAGE NO	173
AVAILABILITY	DEP. NTIS, PC A08/MF A01.
DATE	MAY 1978
CATEGORIES	EDB-200102
PRIMARY CAT	EDB-200102
REPORT NO	EPRI-ER--698(VOL.2)
ABSTRACT	RESEARCH AND DEVELOPMENT EFFORTS ARE CURRENTLY BEING PURSUED FOR A NUMBER OF ADVANCED POWER GENERATION TECHNOLOGIES WHICH HAVE A POTENTIAL FOR CONTRIBUTING TO THE NATIONAL ENERGY SITUATION. THIS STUDY ASSESSED THE POTENTIAL ROLE OF SIX SUCH ADVANCED TECHNOLOGIES IN SMALL MUNICIPAL AND RURAL ELECTRIC UTILITY SYSTEMS BY COMPARING THE ECONOMICS OF UTILIZING THESE ADVANCED TECHNOLOGIES WITH THE ECONOMICS OF CONVENTIONAL GENERATION TYPES. THE TECHNOLOGIES EXAMINED INCLUDED: A 5-MW COAL-FIRED DIESEL ENGINE; A 5-MW COAL-FIRED CLOSED-CYCLE COMBUSTION TURBINE; A 2-MW COAL-FIRED STIRLING ENGINE; A 2-MW OIL-FIRED STIRLING ENGINE; A 1-MW ORGANIC RANKINE CYCLE BOTTOMING ON A 5-MW DIESEL ENGINE; AND A 1-MW TWO-PHASE ENGINE BOTTOMING ON A 5-MW DIESEL ENGINE. THE RESULTS OF THE STUDY INDICATE THAT IF THE CHARACTERISTICS ASSUMED FOR THESE TECHNOLOGIES CAN BE ACHIEVED THEN: THE OIL-FIRED TECHNOLOGIES (OIL-FIRED STIRLING ENGINE, ORGANIC RANKINE CYCLE/DIESEL, AND TWO-PHASE ENGINE/DIESEL) COULD PENETRATE A SIGNIFICANT PORTION OF THE FUTURE SMALL UTILITY MARKET. THEY WILL MOST LIKELY BE EMPLOYED AS INTERMEDIATE DUTY GENERATORS AND THEIR ACTUAL ABILITY TO PENETRATE THE MARKET WILL DEPEND ON THEIR ACTUAL

SELLING PRICE AND HEAT RATE. IF THE HEAT RATES PROJECTED HEREIN ARE ACHIEVED SIGNIFICANT MARKET PENETRATION COULD BE REALIZED AT CAPITAL COSTS OF $250 TO $300 PER KILOWATT IN 1975 DOLLARS. THE COAL-FIRED TECHNOLOGIES (COAL-FIRED DIESEL, CLOSED-CYCLE COMBUSTION TURBINE, AND COAL-FIRED STIRLING ENGINE) ARE NOT COMPETITIVE WITH BASE LOAD CAPACITY FROM JOINT ACTION PROJECTS BUT MAY BE COMPETITIVE WITH PURCHASED BASE LOAD CAPACITY. SPECIFICALLY, THE COAL-FIRED DIESEL HAS THE LOWEST BREAK-EVEN CAPITAL COST AND EVEN ALLOWING FOR THE UNCERTAINTIES OF OPERATION AND MAINTENANCE COSTS WOULD BE ONLY MARGINALLY ATTRACTIVE AT A COST ABOVE $500/KW. THE COAL-FIRED COMBUSTION TURBINE AND THE COAL-FIRED STIRLING ENGINE COULD BE ATTRACTIVE AT COSTS BELOW $450/KW AND $650/KW RESPECTIVELY.

DESCRIPTORS — COAL;COMPARATIVE EVALUATIONS;COST;DIESEL ENGINES: T2;ECONOMICS: Q2,Q3,Q4,Q5,Q6;ELECTRIC GENERATORS;ELECTRIC POWER;ELECTRIC UTILITIES: Q1;GAS TURBINES: T4;MARKET;PETROLEUM;POWER GENERATION: T6;RANKINE CYCLE POWER SYSTEMS: T5;RURAL AREAS: T1; STIRLING ENGINES: T3;TECHNOLOGY ASSESSMENT: Q2,Q3,Q4,Q5

S-19

ACCESSION NO. — 78J0085330
TITLE — PROSPECTS OF CERAMICS IN STIRLING ENGINES
AUTHORS — HOLGERSSON, S.; LIA, T.; GUMMESSON, S.
PUB DESC — DIESEL ENG., V. 73, NO. 795, PP. 213-219
DATE — WIN 1977
CATEGORIES — EDB-330201;360200
PRIMARY CAT — EDB-330201
ABSTRACT — LOW NOISE LEVEL, LOW CONTENT OF HAZARDOUS EXHAUSTS AND MULTI-FUEL ACCEPTANCE ARE SOME INTERESTING QUALITIES OF THE STIRLING ENGINE, MAKING IT AN ENVIRONMENTALLY-COMPATIBLE ENERGY CONVERTER FOR SPECIAL MARKETS WHERE SUCH PROPERTIES ARE IMPORTANT. HOWEVER, WITH DEPLETING ENERGY SOURCES ANOTHER QUALITY--ITS POTENTIAL FOR HIGH EFFICIENCY--IS BECOMING MOST IMPORTANT. THE STIRLING ENGINE'S EFFICIENCY IS HIGHLY DEPENDENT ON HIGH TEMPERATURE MATERIALS LIKE CERAMICS. ALSO INTERESTING FROM THE POINT OF VIEW OF REDUCING COSTS. A DISCUSSION IS GIVEN OF THE OUTLOOK FOR CERAMICS IN STIRLING ENGINES AND WHAT IS BEING DONE IN THIS AREA AT UNITED STIRLING OF SWEDEN, WHERE STIRLING ENGINE DEVELOPMENT HAS BEEN CARRIED OUT SINCE 1968.
DESCRIPTORS — CERAMICS;DESIGN;EXHAUST GASES;FUEL CONSUMPTION;MATERIALS: Q1; PERFORMANCE;RESEARCH PROGRAMS;STIRLING ENGINES: T1;TECHNOLOGY ASSESSMENT

S-20

ACCESSION NO. — 78R0060249
TITLE(MONO) — STIRLING TOTAL ENERGY SYSTEMS STUDY. FINAL REPORT, MAY 15, 1976--JUNE 15, 1977
EDITOR OR COMP — LEHRFELD, D.
CORPORATE AUTH — PHILIPS LABS., BRIARCLIFF MANOR, N.Y. (USA)
PAGE NO — 190
AVAILABILITY — DEP. NTIS, MF A01.
DATE — AUG 1977
CATEGORIES — EDB-320100;290100;291000
PRIMARY CAT — EDB-320100
REPORT NO — HCP/T2947--1
ABSTRACT — THE APPLICATION OF STIRLING CYCLE PRIME MOVERS TO TOTAL ENERGY POWER GENERATION SYSTEMS WAS INVESTIGATED. ELECTRICAL, HEATING, AND COOLING DEMAND PROFILES FOR A TYPICAL RESIDENTIAL COMPLEX, HOSPITAL, AND OFFICE BUILDING WERE STUDIED, AND ALTERNATIVE STIRLING TOTAL ENERGY SYSTEMS WERE CONCEPTUALIZED FOR EACH SITE. THESE WERE ANALYZED IN DETAIL AND CONTRASTED WITH PURCHASED-POWER SYSTEMS FOR THESE SITES TO DETERMINE FUEL-ENERGY SAVINGS AND INVESTMENT ATTRACTIVENESS. THE RESIDENTIAL COMPLEX AND HOSPITAL WOULD BE EXCELLENT CANDIDATES FOR TOTAL ENERGY SYSTEMS, AND PRIME MOVERS IN THE 1000 KW OUTPUT RANGE WOULD BE REQUIRED. STIRLING ENGINES WITH SO LARGE AN OUTPUT HAVE NOT BEEN BUILT TO DATE, ALTHOUGH THERE WOULD BE NO FUNDAMENTAL TECHNICAL BARRIER TO PREVENT THIS. HOWEVER, CAREFUL CONSIDERATION MUST BE GIVEN TO THE FOLLOWING TECHNOLOGICAL DECISION AREAS BEFORE ARRIVING AT A FINAL DESIGN, IF ITS POTENTIAL IS TO BE REALIZED: ENGINE CONFIGURATION, OUTSIDE HEAT EXCHANGE INTERFACE, ENGINE CONTROL SYSTEM, INTERNAL GAS SEALS, AND ADVANCED COAL COMBUSTION TECHNOLOGY. THE PRINCIPAL ADVANTAGE OF A STIRLING PRIME MOVER IN THIS APPLICATION, IN VIEW OF NATIONAL CONCERN OVER PRESENT AND FUTURE DEPENDENCE ON OIL, IS THAT IT COULD UTILIZE LOW-GRADE LIQUID FUELS AND COAL.
DESCRIPTORS — AIR CONDITIONING;APARTMENT BUILDINGS: T1;CO-GENERATION; COMMERCIAL BUILDINGS: T3;DESIGN;ECONOMICS: Q4;ENERGY CONSERVATION: Q1,Q2,Q3;FEASIBILITY STUDIES: Q4;FUELS;HEAT EXCHANGERS;HOSPITALS: T2;OPERATION;PERFORMANCE: Q4;POWER GENERATION;SPACE HEATING;STIRLING CYCLE;STIRLING ENGINES;TOTAL ENERGY SYSTEMS: T4,Q1,Q2,Q3

S.21 Walker, G., "Stirling Engines", Vols. 1&2, September 1978, Printed and the University of Calgary. Alberta, Canada.

S.22 Neal, J., "The Role of Stirling Engines in Tower Systems", Seminar Proceedings Stirling Cycle Prime Movers, Presented June 14-15, 1978, Rosemont, Illinois. Sponsored by the Institute of Gas Technology, IIT Center, 3424 S. State Street, Chicago, Illinois 60616. Published by IGT.

S.26 Uherko, K.L., Holfs, R.E., and Bunker, W. "Overview of DOE's Large Stationary Stirling Engine Development Program", Paper presented at the 16th IECEC, Atlanta, Georgia, 1981.

S.27 Private communication with MTI, Donald D. Colosimo, May 1981.

S.28 Private communication with United Stirling, Inc., Bengt Hallare, May, 1981.

S.29 Private communication with Sunpower, Inc., William Beale, May, 1981.

S.30 Private communication with Stirling Power Systems, Inc., John G. Agno, May, 1981.

ORGANIC RANKINE CYCLE (ORC) ENERGY CONVERSION SYSTEMS

Analysis

Enough information was gathered to allow the determination of the efficiency of this system as a function of turbine inlet temperature and as a function of size in kW, and also to determine the functional dependence of the acquisition cost as a function of size in kW. The data sets used in these analyses are reported in Tables 18 and 19.

Applying the least squares analysis technique to these data sets resulted in the following functions:

<u>ORC System Efficiency (ORF)</u>

$$ORF_T = 5.369 \times 10^{-2} + 3.361 \times 10^{-4} (T) \quad (20)$$

Standard Deviation = 3.500×10^{-2}

$$ORF_S = 8.284 \times 10^{-2} (\log x) \quad (21)$$

Standard Deviation = 1.900×10^{-2}

<u>ORC System Acquisition Cost (ORAC)</u>

$$ORAC = 1.3990 \times 10^3 - 7.3200 \times 10^2 (\log x) + 1.5700 \times 10^2 (\log x)^2 \quad (22)$$

Standard Deviation = 1.120×10^2

where:

T = turbine inlet temperature, °F

x = size, kW.

Predicted values of ORC efficiency as a function of turbine inlet temperature based on Equation 20 are shown in Table 20. Predicted values of ORC efficiency as a function of size (kW) based on Equation 21 are shown in Table 21. Predicted values based on Equation 22 are also shown in Table 21. Equations 20, 21, and 22 are also plotted along with the corresponding data in Figures 17, 18, and 19, respectively. If the last data point in Table 19 is dropped because it appears in disagreement with the expected trend, Equation 22 would become:

$$ORAC = 1.2890 \times 10^3 - 6.7600 \times 10^2 (\log x) + 1.3200 \times 10^2 (\log x)^2 \quad (23)$$

Standard deviation = 4.800×10^1

Predicted values based on Equation 23 are shown in Table 21, and Equation 23 is plotted in Figure 20.

Table 18. DATA USED IN THE DETERMINATION OF THE DEPENDENCE OF THE ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM EFFICIENCY ON THE TURBINE INLET TEMPERATURE

T(°F)	EFFICIENCY
150	0.090
200	0.115
200	0.100
250	0.150
350	0.200
400	0.200
450	0.250
550	0.180
750	0.300
800	0.310
800	0.380
800	0.285

Table 19. DATA USED IN STATISTICAL ANALYSIS FOR DIFFERENT PARAMETERS OF THE ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM

Power System Size, kW	System Efficiency	Acquistion Cost ($/kW)
0.96	0.013	--
1.00	--	1397
1.90	0.022	--
3.20	0.031	--
8	0.060	--
10	--	825
16	0.095	--
24	0.120	--
32	0.136	--
19	0.147	--
100	--	572
750	0.220	600
1000	--	508 & 523
1125	--	800

Table 20. EFFICIENCY VALUES FOR THE ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM AS PREDICTED FROM EQUATION 20

Temp. °F	Efficiency
100	0.087
250	0.138
500	0.222
750	0.306
1000	0.390

Information on other quantitative parameters for this sytem is scarce and does not allow meaningful statistical analysis. Consequently a best judgment is made based on the available information.

Weight

Table 21. VALUES OF THE DIFFERENT ORC ENERGY CONVERSION SYSTEM PARAMETERS AS PREDICTED FROM EQUATIONS 21, 22, AND 23

System Size, kW	(Equation 21) Efficiency	(Equation 22) Acquisition Cost ($/kW)	(Equation 23) Acquisition Cost* ($/kW)
1.5	0.015	1275	1274
5.0	0.058	964	981
20.0	0.108	712	732
30.0	0.122	659	678
60.0	0.147	592	604
100.0	0.166	562	564
250.0	0.199	544	525
750.0	0.238	590	534
1000.0	0.249	613	546
5000.0	0.306	979	691

* Without apparently spurious data point.

Operation and Maintenance Cost

Sufficient data are not yet available.

Lifetime

The average operational lifetime of an Organic Rankine System is expected to be about 20 years. During that period, it requires about four or five major overhauls. Overheating or contamination of the organic material may cause its decomposition and therefore more frequent replacement will be required.

Mobility

Organic Rankine Systems are generally available in small sizes of under 1 MW and are mobile.

Other Energy Production

Since Organic Rankine Cycles are required to utilize lower temperature heat sources the rejected heat after the power generation process is generally very low grade heat and of very little use.

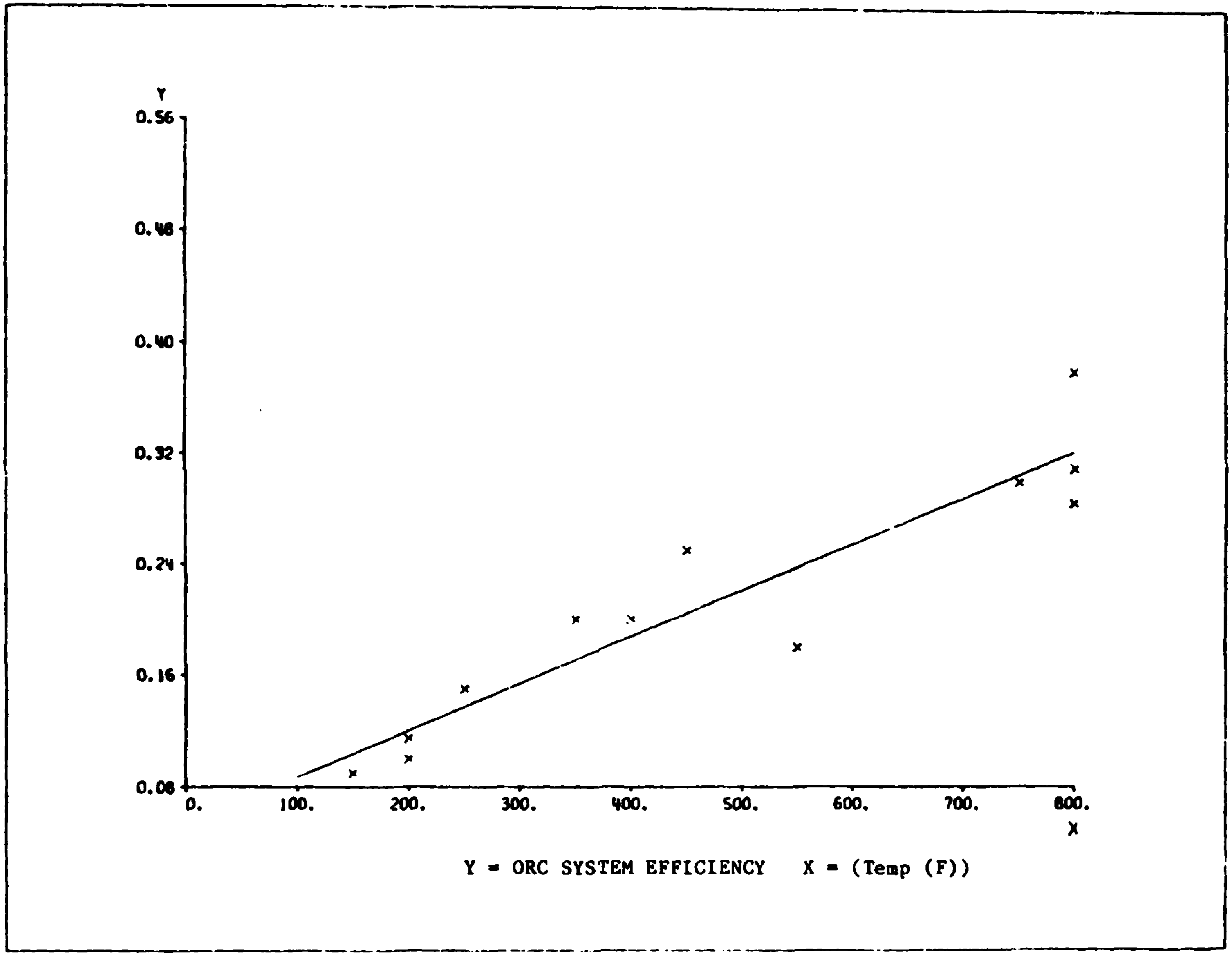

Figure 17. ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM EFFICIENCY VERSUS INLET TEMPERATURE

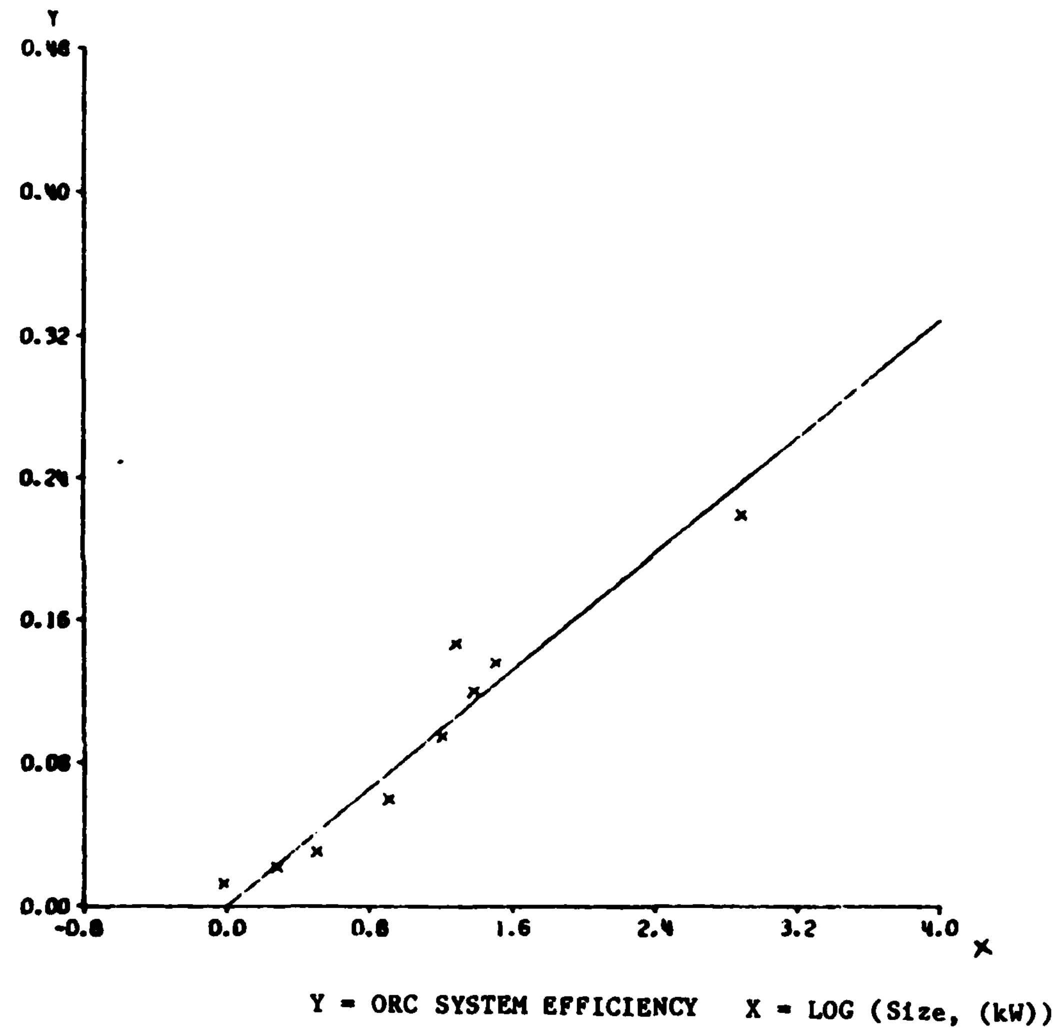

Figure 18. ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM EFFICIENCY VERSUS SIZE

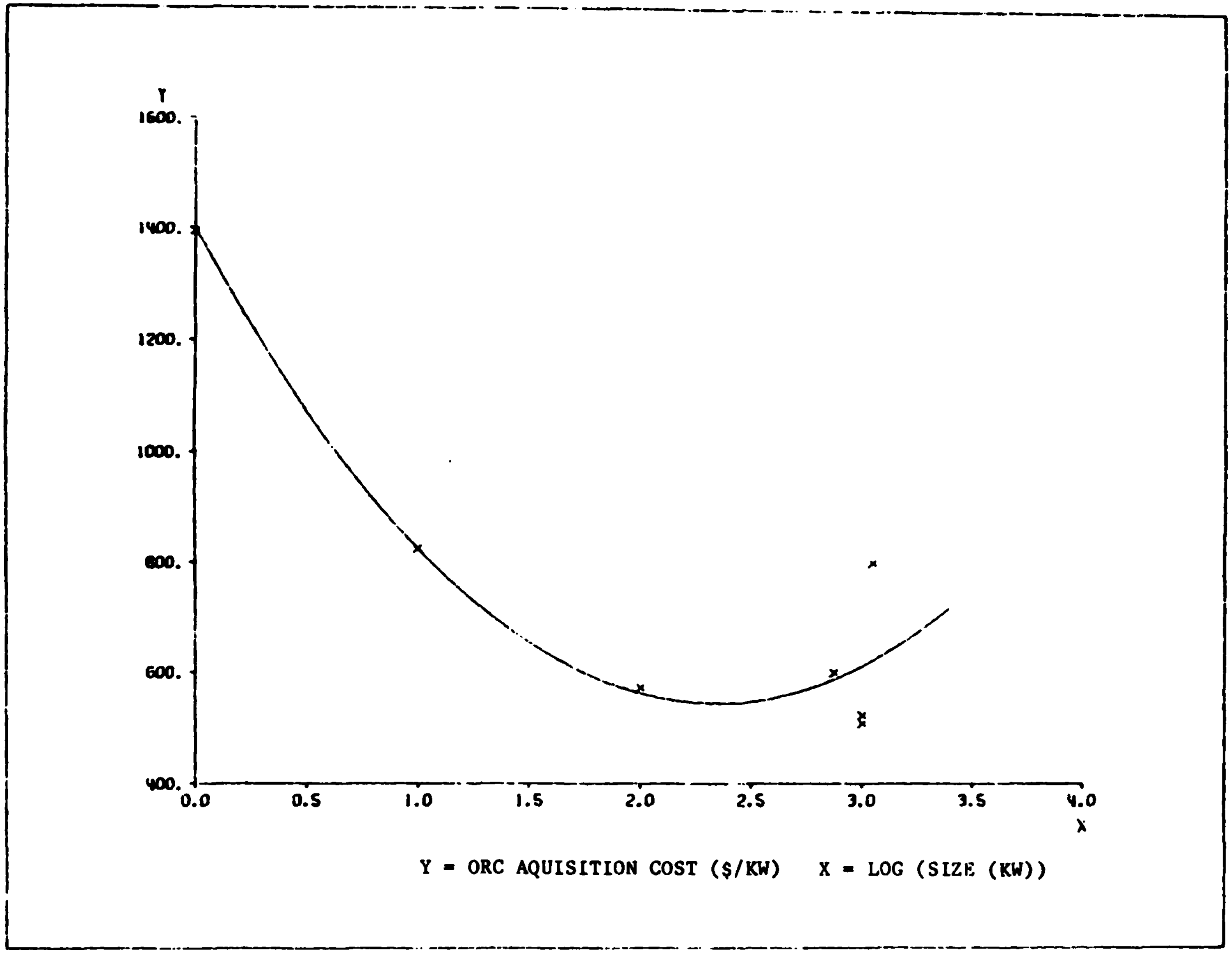

Figure 19. ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM ACQUISITION COST VERSUS SIZE

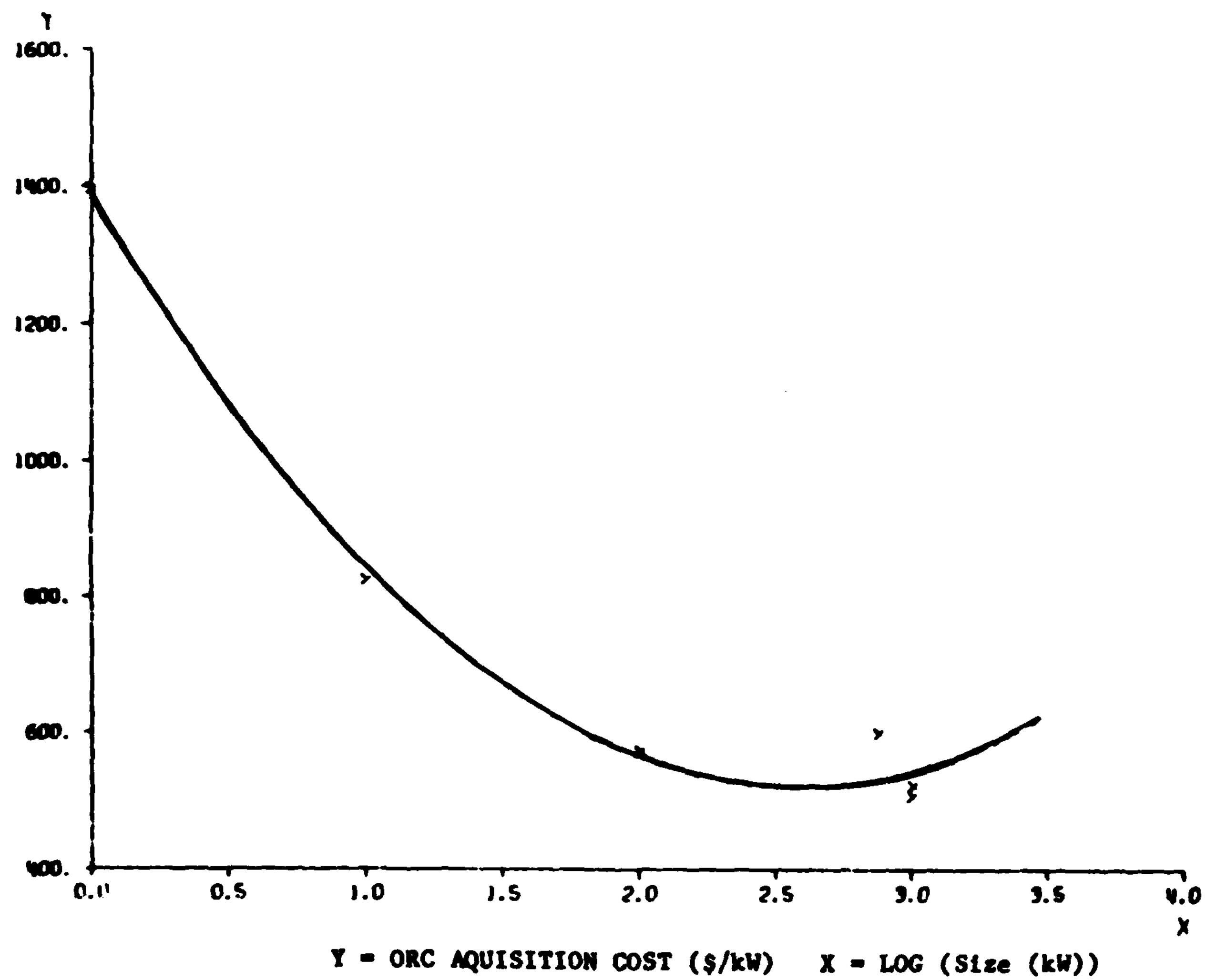

Figure 20. ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM ACQUISITION COST VERSUS SIZE

Availability of Raw Material

These systems are constructed primarily of iron and nickel-based metal alloys. Adequate supply of these metals is expected to continue at least in the near future. Further, because these systems operate at lower tempertures less material problems are encountered. The corrosion problem can be controlled through the use of non-reactive organic compounds as working fluids.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 22, 23, 24, and 25, respectively.

Table 22. ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM LOCATION CONSTRAINTS

Constraint	Heat Source: Solar	Heat Source: Heat Recovery	Heat Source: Fossil Fuel Fired	Remarks
1. Water Requirements	—	—	—	—
2. Manning Requirements	—	—	—	Minimal attention and normal inspection procedures are enough
3. Fuel Availability and Delivery	—	—	0	Delivery to fossil fuel based units is a problem cause it is affected by weather and road conditions
4. Fuel Storage	—	—	—	—
5. Other	●	—	0	Solar insolation or emissions

Overall Assessment: The ordinal score is 5 indicating minimum locational constraints.

Table 23. ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM OPERATION CONSTRAINTS

Constraint	Heat Source: Solar	Heat Source: Heat Recovery	Heat Source: Fossil Fuel Fired	Remarks
1. Part Load Capability and Efficiency	0	●	0	For heat recovery arrangements a back-up heat sink will be required. Efficiency is also reduced at part-load
2. Overload Capability and Efficiency	●	●	0	
3. Load Following Capability	●	●	0	

Overall Assessment: The ordinal score is 2 indicating turn-down capability with high efficiency penalty.

75(3)/RPE/61045Q

Table 24. ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM RELIABILITY

Constraint	Heat Source: Solar	Heat Recovery	Fossil Fuel Fired	Remarks
1. Moving Parts	●	●	●	—
2. Operating Temperature	●	●	O	For the solar and heat recovery systems temperature fluctuations are possible
3. Modularity of the Design	●	●	●	—
4. Stress Levels	O	O	O	—
5. Corrosion	O	O	O	—
6. Other	●	—	—	Solar arrangement is unpredictable because of weather conditions

Overall Assessment: The overall score is 2 indicating moderate potential unreliability.

75(3)/RPE/61045Q

Table 25. ORGANIC RANKINE CYCLE ENERGY CONVERSION SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Control	Degree of Difficulties in Meeting More Strict Regulations	Remarks
• Thermal Discharge	---	---	---	
• Air Pollution				
CO	0	0	0	---
NO_x	0	0	●	low temperature
SO_x	●	0	0	depends on S content of the fuel
HC	0	0	0	
Particulates	0	0	●	
Other	---	---	---	
• Noise	0	0	0	
• Odor	---	---	---	Only if coal is used
• Solid waste	---	---	---	
• Chemical Waste	---	---	---	

Overall Assessment: The ordinal score is 4 indicating moderate potential environmental constraint.

75(3)/RPE/61045Q

ORGANIC RANKINE CYCLE (ORC) ENERGY CONVERSION SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Organic Rankine Cycle

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value		Plant Size, kW	Assumptions of Advanced State of the Art	
	Study	Operating Plant		Working Temp. °F	Working Fluid
R. 25*	0.090			150	R114
	0.115			200	R114
	0.150			250	R114
	0.20			350	Benzene
	0.25			450	Benzene
	0.31			800	Benzene
	0.30			750	Toluene
R. 7	0.285		22	800	
R. 5	0.11			100	
	0.15			200	
	0.18			300	
	0.20			400	
	0.21			500	
	0.22			600	
R. 37	0.422		1000	#2 fuel oil	
R. 38*	0.10			200	
	0.20			400	
	0.38			800	
R. 34	0.21				Projected in 1972
R. 41		0.18 (Gross)	200	550	Toluene (test facility)
R. 41		0.159(Net)			
R. 42		0.060	8		Maximum value for different condensor inlet pressures read from a curve
		0.095	16		
		0.12	24		
		0.136	32		
		0.147	19		Shallow well irrigation experiment (shaft power/heat input)
R. 43		0.031	3.20		Gross efficiencies (3 kWe Rankine Cycle system using R. 12
		0.022	1.90		
		0.013	0.96		
R. 44		0.22	750		

*recorded data read from a graph presented in this reference.

DATA SHEET

Energy Conversion System: Organic Rankine Cycle

Parameter: Volume/Size (Ft^3/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
R. 29	6.76			
R. 35	0.16-0.2			For transportation application
R. 44		6.5	750	

DATA SHEET

Energy Conversion System: Organic Rankine Cycle

Parameter: Weight (Lbs/Kw)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
R. 7	29.7		22	Total system weight
R. 35	7-11			Projected fro transportation applications
R. 44		130	750	

DATA SHEET

Energy Conversion System: Organic Rankine Cycle

Parameter: Start-up/Shutdown Time (Min.)

Energy Conversion System Reference	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
R. 34	2.			Bus move from cold start
	5.			develop full power
R. 35	0.50			To develop full power from cold start in 1972
	< 0.16			Projected for future transportation applications
R. 44		30		Start-up
		0		Shutdown

DATA SHEET

Energy Conversion System: Organic Rankine Cycle

Parameter: O & M Cost (10^{-3} \$/KwHr) (In 1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
R. 37	3.54		1000	
R. 44		1.5	750	

DATA SHEET

Energy Conversion System: Organic Rankine Cycle

Parameter: Aquisition Cost ($/Kw) (In 1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
R. 25	508±65		1000	Projected
	572±65		100	Projected
	825±65		10	Projected
	1397±260		1	Projected
R. 37	523		1000	Estimate
R. 38	800		1125	Year to which cost refer. is unknown. Number reflects installed cost.
R. 29	1355		150	Production rate
	2597		150	First unit
R. 44		600	750*	Using by-phase turbine
		900	750**	
R. 39		7180	34.2	45 HP unit to recover heat from diesel trucks.
		1550	34.2	Installation cost (per kW) for 45 HP unit described above. These values are for the test unit only
R. 4	3,540-11,800		150	Irrigation Appl. Estimate
R. 40	415		206	Bottoming cycle on a diesel generator.

* capital cost

**installed cost

DATA SHEET

Energy Conversion System: Organic Rankine Cycle

Parameter: Lifetime,Hrs

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
R. 38	123,000		1125	(15 yrs.,8200 hrs/yr)
R. 44			750	(20 years)

DATA SHEET

Energy Conversion System: Organic Rankine Cycle

Parameter: Operational Constraints

Constraint	Energy Conversion Systems Reference: Studies	Energy Conversion Systems Reference: Operating Plants
Environmental	R. 34, R. 35	–
Thermal Discharge		
Air Pollution		
Noise		
Solid Waste		
Chemical Waste		
Location		
Water Requirements		
Manning Requirements		
Fuel Delivery		
Solar Insolation		
Wind Requirement		
Metropolitan Siting		
Electrical Power Requirement		
Operational		
Part Load Efficiency		
Part Load Capability		
Solar, Wind Dependence		
Overload Capacity		
Load Following		
Life Dependence on Cycling		

ORGANIC RANKINE CYCLE (ORC) ENERGY CONVERSION SYSTEMS

Bibliography

R-1

ACCESSION NO.	80C0082910
REPORT NO.PAGE	CONF-800340 PP. 1.26-1.29
TITLE	DEVELOPMENT OF A SOLAR-POWERED 16-TON RANKINE CYCLE HEAT PUMP
AUTHORS	BIANCARDI, F.R.; MELIKIAN, G.; SITLER, J.W.
AUTHOR AFF	UNITED TECHNOLOGY CORP., E. HARTFORD, CT
TITLE(MONO)	PROCEEDINGS OF THE ANNUAL DOE ACTIVE SOLAR HEATING AND COOLING CONTRACTORS' REVIEW MEETING
PAGE NO	1.26-1.29
AVAILABILITY	NTIS, PC A18/MF A01.
CONF TITLE	DOE ACTIVE SOLAR HEATING AND COOLING CONTRACTORS' REVIEW MEETING
CONF PLACE	LAKE TAHOE, NV, USA
CONF DATE	26 MAR 1980
DATE	1980
CATEGORIES	EDB-140901
PRIMARY CAT	EDB-140901
REPORT NO	CONF-800340--
ABSTRACT	UNITED TECHNOLOGIES HAS DESIGNED, BUILT AND IS TESTING A UNIQUE THERMALLY-DRIVEN HEAT PUMP, SIZED FOR MULTI-FAMILY RESIDENTIAL APPLICATIONS. THIS PROTOTYPE UNIT WAS SPECIFICALLY DESIGNED TO OPERATE AT PEAK TEMPERATURES TYPICAL OF MEDIUM-CONCENTRATION COLLECTORS AND TO PERMIT EFFICIENT AIR COOLING. THE BASIC HEAT PUMP DESIGN DATA WAS DEVELOPED UNDER PRIOR ERDA- AND DOE-SPONSORED PROGRAMS IN WHICH THE OPERATIONAL FEASIBILITY AND PERFORMANCE CHARACTERISTICS OF A LABORATORY RANKINE-CYCLE TURBOCOMPRESSOR HEAT PUMP AND AIR CONDITIONING SYSTEM WERE DEMONSTRATED. SYSTEM DESIGN, TESTING, PERFORMANCE, AND ECONOMICS ARE DESCRIBED.
DESCRIPTORS	APARTMENT BUILDINGS: T1;ECONOMIC ANALYSIS;HEAT PUMPS: T4; OPERATION;PERFORMANCE;RANKINE CYCLE ENGINES: Q2,Q3;SOLAR AIR CONDITIONERS: T2;SOLAR AIR CONDITIONING: Q1;SOLAR HEAT ENGINES: Q4;SOLAR HEATING SYSTEMS: T3;SOLAR SPACE HEATING: Q1;VAPOR COMPRESSION REFRIGERATION CYCLE

R-2

ACCESSION NO.	80C0082909
REPORT NO.PAGE	CONF-800340 PP. 1.22-1.25
TITLE	CHILLER DRIVEN BY A SOLAR STEAM-POWERED RANKINE ENGINE (SSPRE)
AUTHORS	LIOR, N.; YEH, H.
AUTHOR AFF	UNIV. OF PENNSYLVANIA, PHILADELPHIA
TITLE(MONO)	PROCEEDINGS OF THE ANNUAL DOE ACTIVE SOLAR HEATING AND COOLING CONTRACTORS' REVIEW MEETING
PAGE NO	1.22-1.25
AVAILABILITY	NTIS, PC A18/MF A01.
CONF TITLE	DOE ACTIVE SOLAR HEATING AND COOLING CONTRACTORS' REVIEW MEETING
CONF PLACE	LAKE TAHOE, NV, USA
CONF DATE	26 MAR 1980
DATE	1980
CATEGORIES	EDB-140901
PRIMARY CAT	EDB-140901
REPORT NO	CONF-800340--
ABSTRACT	THE OBJECTIVE OF THIS PROJECT IS THE DESIGN, FABRICATION, TESTING AND ANALYSIS OF A SOLAR-POWERED HEAT ENGINE/VAPOR COMPRESSION CYCLE CHILLER OF 15 TO 25 TON CAPACITY. THE CHILLER SHALL BE DESIGNED FOR EFFICIENT OPERATION WITH SOLAR-HEATED FLUID SUPPLY TEMPERATURES OF 220$SUP 0$ TO 300$SUP 0$F, AND BE AIR-COOLED. PROGRESS IS REPORTED. (WHK)
DESCRIPTORS	COST;EFFICIENCY;RADIAL-OUTFLOW REACTION TURBINES;RANKINE CYCLE ENGINES: Q1;RESEARCH PROGRAMS: Q1;SOLAR AIR CONDITIONERS: T1; SOLAR HEAT ENGINES;STEAM;SUPERHEATING;VAPOR COMPRESSION REFRIGERATION CYCLE

R-3

ACCESSION NO.	80C0082907
REPORT NO.PAGE	CONF-800340 PP. 1.13-1.18
TITLE	RANKINE CYCLE SOLAR DRIVEN HEAT PUMP DEVELOPMENT (1976 TO 1979)
AUTHORS	GRAF, J.C.
AUTHOR AFF	GENERAL ELECTRIC CO., PHILADELPHIA, PA
TITLE(MONO)	PROCEEDINGS OF THE ANNUAL DOE ACTIVE SOLAR HEATING AND COOLING CONTRACTORS' REVIEW MEETING
PAGE NO	1.13-1.18
AVAILABILITY	NTIS, PC A18/MF A01.
CONF TITLE	DOE ACTIVE SOLAR HEATING AND COOLING CONTRACTORS' REVIEW MEETING
CONF PLACE	LAKE TAHOE, NV, USA
CONF DATE	26 MAR 1980

	DATE	1980
	CATEGORIES	EDB-140901
	PRIMARY CAT	EDB-140901
	REPORT NO	CONF-800340--
	ABSTRACT	THE DEVELOPMENT, PRINCIPLES OF OPERATION, PERFORMANCE, AND ECONOMICS OF THE SOLAR RANKINE CYCLE-DRIVEN HEAT PUMP UNDER DEVELOPMENT BY GENERAL ELECTRIC ARE DISCUSSED. THE SYSTEM UTILIZES EVACUATED TUBE COLLECTORS AND A TWO-STAGE MULTIVANE EXPANDER. (WHK)
	DESCRIPTORS	COEFFICIENT OF PERFORMANCE;ECONOMICS;EVACUATED TUBE COLLECTORS; EVAPORATORS;HEAT PUMPS;OPERATION;PERFORMANCE;RANKINE CYCLE ENGINES: Q1;RESEARCH PROGRAMS: Q1;SOLAR COOLING SYSTEMS: T1; VAPOR CONDENSERS
R-4	ACCESSION NO.	80C0082863
	TITLE	SOLAR POWERED DEEP WELL PUMPING EXPERIMENT
	AUTHORS	LARSON, D.L.; SANDS, C.D. II
	AUTHOR AFF	UNIV OF ARIZ, TUCSON
	PUB DESC	ASAE TECH. PAP., P. 7
	SEC REPT NO	CONF-7906167--
	CONF TITLE	ASAE AND CSAE CANADIAN SOCIETY OF AGRICULTURAL ENGINEERING SUMMER MEETING
	CONF PLACE	WINNIPEG, CANADA
	CONF DATE	24 JUN 1979
	DATE	1979
	CATEGORIES	EDB-140703;140909
	PRIMARY CAT	EDB-140703
	ABSTRACT	THE PAPER DISCUSSES THE DESIGN, CONSTRUCTION, OPERATION AND EVALUATION OF A 150 KW SOLAR POWER PLANT. PLANT SIZE WAS SELECTED TO MEET THE ENERGY REQUIREMENTS OF DEEP WELL PUMPING TO PROVIDE IRRIGATION WATER FOR A QUARTER SECTION OR 160 ACRES OF ARIZONA CROPLAND. AN IMPORTANT FACTOR IN SITE SELECTION WAS COOPERATION OF THE LOCAL UTILITY COMPANY. BACKUP ENERGY IS REQUIRED TO ASSURE PUMP OPERATION. THE PLANT INCLUDES PARABOLIC TROUGH TYPE COLLECTORS AND RANKINE CYCLE TURBINE ENGINE. THE PLANT WILL GENERATE ELECTRICITY FOR PUMPING AND BE INTERCONNECTED WITH THE UTILITY SYSTEM. REFS.
	DESCRIPTORS	ARIZONA;DESIGN: Q1,Q2;DISTRIBUTED COLLECTOR POWER PLANTS: T1; FARMS;IRRIGATION: T3;OPERATION;PARABOLIC TROUGH COLLECTORS; POWER RANGE 100-1000 KW;RANKINE CYCLE ENGINES;SOLAR HEAT ENGINES;SOLAR WATER PUMPS: T2,Q3;WATER PUMPS;WELLS
R-5	ACCESSION NO.	80R0082860
	TITLE(MONO)	SOLAR POWERED RANKINE CYCLE IRRIGATION PUMP. FINAL REPORT
	EDITOR OR COMP	BATTON, W.D.; BARBER, R.E.
	CORPORATE AUTH	BARBER-NICHOLS ENGINEERING CO., ARVADA, CO (USA)
	SEC REPT NO	SAN--0419-1
	PAGE NO	87
	AVAILABILITY	NTIS, PC A05/MF A01.
	CONTRACT NO	CONTRACT AC03-78ET20419
	DATE	SEP 1979
	CATEGORIES	EDB-140703
	PRIMARY CAT	EDB-140703
	REPORT NO	DOE/ET/20419--1
	ABSTRACT	A NEW AND NOVEL MEANS OF COMBINING SOLAR ENERGY WITH THE RANKINE ENGINE IS TO USE THE COLLECTORS AS THE ENGINE BOILER. THIS REPORT DETAILS THE RESULTS OF A TEST PROGRAM WHERE A SMALL (288 SQUARE FEET) COLLECTOR FIELD WAS INSTALLED AND USED FOR BOILING-IN-THE-COLLECTOR TESTS WITH R-113 AS A WORKING FLUID. TWO DIFFERENT TYPES OF PARABOLIC TROUGH TRACKING COLLECTORS WERE PURCHASED AND TESTED. THERE WERE TWO ROWS (128 SQ. FT.) OF DEL MANUFACTURING COLLECTORS AND ONE ROW (160 SQ. FT.) OF SOLAR KINETICS COLLECTORS. ALL THREE ROWS WERE INSTALLED AT A 5 DEGREE ANGLE (INCLINED TO THE SOUTH) ORIENTED NORTH-SOUTH AND TRACKING EAST-WEST ON THE ROOF AT BARBER-NICHOLS IN ARVADA, COLORADO, A NORTHWEST SUBURB OF DENVER. THESE TWO TYPES OF COLLECTORS HAVE DISTINCT DIFFERENCES THAT MADE IT WORTHWHILE TO TEST EACH TYPE. A RANKINE ENGINE, LESS TURBINE EXPANDER, WAS INSTALLED AND USED TO COMPLETE A SOLAR POWER SYSTEM. THE MAJOR EXPERIMENTAL RESULTS ARE THAT THE COLLECTORS DID HEAT THE R-113, DID PROVIDE A VAPOR SUITABLE FOR TURBINE FEED, AND STABLE FLOW DID OCCUR UNDER ALL CONDITIONS, THUS PROVING THE

FEASIBILITY OF THE BOILING-IN-COLLECTOR CONCEPT. ALSO, THE 5 DEGREE ANGLE PERFORMED SATISFACTORILY AND IS CONSIDERED A REASONABLE ANGLE FOR FIELD USE. SOME UNEXPECTED PROBLEMS WERE EXPERIENCED IN TESTING THE COLLECTORS. THE FEASIBILITY OF THE SYSTEM CONCEPT HAS BEEN DEMONSTRATED AND AREAS FOR IMPROVEMENT HAVE BEEN DETERMINED. METHODS TO RESOLVE THESE AREAS ARE PROPOSED ALONG WITH A PLAN TO EXPAND THE SYSTEM, COMPLETE THE ENGINE, AND TO GATHER OPERATING EXPERIENCE AND PERFORMANCE DATA FOR A YEAR'S OPERATION. BUDGET AND SCHEDULE ARE PROVIDED FOR THIS PROPOSED FOLLOW ON WORK. (WHK)

DESCRIPTORS: COLORADO;COST;DESIGN;EFFICIENCY;ERRORS;FARMS;IRRIGATION;MARKET; PARABOLIC TROUGH COLLECTORS;PERFORMANCE;PERFORMANCE TESTING: Q1,Q2;RANKINE CYCLE ENGINES: Q1,Q2;SOLAR HEAT ENGINES: T2;SOLAR WATER PUMPS: T1;SYSTEMS ANALYSIS

R-6

ACCESSION NO.: 80U0082850
REPORT NO,PAGE: DOE/JPL--1060-33 PP. 235-239
TITLE: 50-HORSEPOWER SOLAR-POWERED IRRIGATION FACILITY LOCATED NEAR GILA BEND, ARIZONA
AUTHORS: SMITH, W.A.; ALEXANDER, G.; BUSCH, D.F.
AUTHOR AFF: BATTELLE COLUMBUS LABS., OH
TITLE(MONO): PROCEEDINGS OF THE FIRST SEMI-ANNUAL DISTRIBUTED RECEIVER SYSTEMS PROGRAM REVIEW
PAGE NO: 235-239
AVAILABILITY: NTIS, PC A12/MF A01.
DATE: 15 APR 1980
CATEGORIES: EDB-140700
PRIMARY CAT: EDB-140700
REPORT NO: DOE/JPL--1060-33
ABSTRACT: THE OPERATION OF THE 50-HORSEPOWER SOLAR-POWERED IRRIGATION FACILITY NEAR GILA BEND, ARIZONA OVER THREE YEARS DEMONSTRATES THE TECHNICAL FEASIBILITY OF SOLAR-POWERED PUMPING. THE RANKINE CYCLE FACILITY WAS BUILT USING 1976 TECHNOLOGY. THE REQUIREMENT NOW IS TO USE THE TECHNOLOGY THAT HAS BEEN DEVELOPED OVER THE LAST FOUR YEARS TO DESIGN A FACILITY SPECIFICALLY FOR THE IRRIGATION FARMER. CONSIDERATIONS TO MEET HIS NEEDS AND TO DEMONSTRATE WHETHER SOLAR THERMAL CONVERSION IS A POTENTIALLY VIABLE APPLICATION FOR PUMPING IRRIGATION WATER IN THE UNITED STATES ARE SUGGESTED.
DESCRIPTORS: ARIZONA;CONCENTRATING COLLECTORS;DESIGN: Q2;FARMS;FLASHING; IRRIGATION: T1;OPERATION;PERFORMANCE;RANKINE CYCLE ENGINES: Q2; SOLAR ABSORBERS;SOLAR TRACKING;SOLAR WATER PUMPS: T2,Q1; SOLAR-ASSISTED HEAT PUMPS;WASHING;WELLS

R-7

ACCESSION NO.: 80U0076489
REPORT NO,PAGE: DOE/JPL--1060-33 PP. 99-105
TITLE: SCSTPE ORGANIC RANKINE ENGINE
AUTHORS: BODA, F.
AUTHOR AFF: FORD AEROSPACE AND COMMUNICATIONS CORP., NEWPORT BEACH, CA
TITLE(MONO): PROCEEDINGS OF THE FIRST SEMI-ANNUAL DISTRIBUTED RECEIVER SYSTEMS PROGRAM REVIEW
PAGE NO: 99-105
AVAILABILITY: NTIS, PC A12/MF A01.
DATE: 15 APR 1980
CATEGORIES: EDB-140703
PRIMARY CAT: EDB-140703
REPORT NO: DOE/JPL--1060-33
ABSTRACT: THE ORGANIC RANKINE CYCLE (ORC) ENGINE UNDER CONSIDERATION FOR THE PFDR SOLAR THERMAL SYSTEM BEING DEVELOPED FOR JPL/DOE BY FACC IS DESCRIBED. DESIGN PARAMETERS, METHOD OF CONTROL, PERFORMANCE AND COST DATA ARE PROVIDED FOR ENGINE POWER LEVELS UP TO 80 KWE; EFFICIENCY IS SHOWN AS A FUNCTION OF TURBINE INLET TEMPERATURE IN THE RANGE OF 149$SUP 0$C (300$SUP 0$F) TO 427$SUP 0$C (800$SUP 0$F).
DESCRIPTORS: CONTROL;COST;DESIGN: Q2;DISTRIBUTED COLLECTOR POWER PLANTS: T1; EFFICIENCY;ORGANIC COMPOUNDS;PARABOLIC DISH COLLECTORS; PERFORMANCE;RANKINE CYCLE ENGINES;RANKINE CYCLE POWER SYSTEMS: T2,Q1;SIZE

R-8

ACCESSION NO.: 80C0055145
REPORT NO,PAGE: SERI/TP--351-431 PP. 383-386

TITLE	RESULTS OF SYSTEMS SIMULATION AND ECONOMIC ANALYSIS OF A SOLAR-POWERED TURBOCOMPRESSOR HEAT PUMP
AUTHORS	MELIKIAN, G.; RHODES, B.W.; OBEE, T.N.
AUTHOR AFF	UNITED TECH. RESEARCH CENTER, EAST HARTFORD, CT
TITLE(MONO)	SYSTEMS SIMULATION AND ECONOMIC ANALYSIS
SEC REPT NO	CONF-800101--
PAGE NO	383-388
AVAILABILITY	DEP. NTIS, PC A22/MF A01.
CONF TITLE	SYSTEMS SIMULATION AND ECONOMICS ANALYSIS CONFERENCE
CONF PLACE	SAN DIEGO, CA, USA
CONF DATE	23 JAN 1980
DATE	1980
CATEGORIES	EDB-140901
PRIMARY CAT	EDB-140901
REPORT NO	SERI/TP--351-431
ABSTRACT	SINCE 1974, UNITED TECHNOLOGIES HAS BEEN ACTIVELY ENGAGED IN THE DESIGN, DEVELOPMENT AND DEMONSTRATION OF SOLAR-POWERED RANKINE CYCLE HEATING AND COOLIG SYSTEMS FOR BUILDING APPLICATIONS. UNDER A RECENT DOE CONTRACT, UTC HAS BUILT AND TESTED AN 18-TON COOLING CAPACITY, 500,000 BTU/HR HEAT PUMP OVER A WIDE RANGE OF OPERATING CONDITIONS SIMULATING AN ACTUAL BUILDING INSTALLATION. TO ASSIST IN THE HEAT PUMP DESIGN AND ANALYSIS, UTRC HAS DEVELOPED AND USED SEVERAL COMPREHENSIVE SYSTEM SIMULATION AND ECONOMIC ANALYSIS PROGRAMS. COLLECTOR ARRAY SIZE, STORAGE TANK VOLUME AND CONTROL STRATEGIES WERE EVALUATED WITH THESE PROCEDURES. TYPICAL RESULTS OF THE SYSTEM SIMULATIONS FOR BUILDINGS IN SIX SELECTED GEOGRAPHICAL REGIONS ARE DESCRIBED AND THE ECONOMIC POTENTIAL FOR SUCH A SYSTEM IS ILLUSTRATED. THE IMPACT OF VARIATIONS IN PROJECTED FUEL PRICE AND COMPONENT COST LEVEL ON THE UTC SYSTEM ECONOMIC POTENTIAL (I.E., RETURN-ON-INVESTMENT, PAYBACK PERIOD, ETC) IS SHOWN IN DETAIL.
DESCRIPTORS	COMPUTERIZED SIMULATION;COST;DESIGN;ECONOMIC ANALYSIS: Q1,Q2; HEAT PUMPS: T3;PERFORMANCE;RANKINE CYCLE ENGINES;SIZE;SOLAR COLLECTORS;SOLAR COOLING SYSTEMS: T2;SOLAR HEAT ENGINES: T,Q3; SOLAR HEATING SYSTEMS: T1;SYSTEMS ANALYSIS: Q1,Q2; TURBOMACHINERY

R-9

ACCESSION NO.	80C0033510
REPORT NO.PAGE	CONF-791229 PP. 209-214
TITLE	DEVELOPMENT OF 2 KW SOLAR POWERED STEAM ENGINE SYSTEM
AUTHORS	DESHPANDE, A.M.; GUPTA, R.K.; BARVE, K.M.; JAIN, B.C.
AUTHOR AFF	JYOTI LTD., BARODA, INDIA
TITLE(MONO)	NATIONAL SOLAR ENERGY CONVENTION 1979 OF SOLAR ENERGY SOCIETY OF INDIA
PAGE NO	209-214
AVAILABILITY	DEP. NTIS (US SALES ONLY), PC A24/MF A01.
CONF TITLE	NATIONAL SOLAR ENERGY CONVENTION
CONF PLACE	BOMBAY, INDIA
CONF DATE	13 DEC 1979
DATE	1979
CATEGORIES	EDB-140703
PRIMARY CAT	EDB-140703
REPORT NO	CONF-791229--
ABSTRACT	A POTENTIALLY ATTRACTIVE USE OF SOLAR ENERGY IS IN THE FORM OF POWER GENERATION FOR DECENTRALIZED APPLICATIONS. A PROJECT ON DEVELOPMENT OF 2 KW STEAM ENGINE SYSTEM USING CYLINDRICAL PARABOLIC CONCENTRATORS WAS UNDERTAKEN TO EVALUATE THE SYSTEM BOTH FROM TECHNOLOGICAL AS WELL AS ECONOMIC POINTS OF VIEW. A DIESEL ENGINE IS CONVERTED INTO A UNIFLOW TYPE, SINGLE ACTING STEAM ENGINE. A MINIMUM SPECIFIC STEAM CONSUMPTION OF 18 KG/KW-H WAS RECORDED DURING THE TESTS ON THE STEAM ENGINE. NEXT GENERATION OF THE STEAM ENGINE, INCORPORATING FURTHER MODIFICATIONS, IS EXPECTED TO OPERATE AT 12 KG/KW-H SPECIFIC STEAM CONSUMPTION JUST ABOUT THE LOWEST SPECIFIC STEAM CONSUMPTION FOR THIS SIZE OF ENGINE. AN ESTIMATION OF YEARLY DISTRIBUTION OF KILOWATT-HOURS WHICH CAN BE PRODUCED BY THE SYSTEM HAS BEEN MADE BASED ON SOLAR INSOLATION DATA OF BARODA STATION. THE DETAILED DESIGNS FOR 7.5 KW AND 10 KW OPTIMIZED SYSTEMS ARE NOW READY WHEREIN THE AUXILIARIES ARE POWERED BY THE STEAM ENGINE ITSELF, THEREBY MAKING THE UNIT INDEPENDENT AND SELF-CONTAINED.
DESCRIPTORS	DESIGN: Q1;DISTRIBUTED COLLECTOR POWER PLANTS: T1;EFFICIENCY;

EVALUATION;OPERATION;PARABOLIC TROUGH COLLECTORS;PERFORMANCE: Q1;POWER RANGE 1-10 KW;RANKINE CYCLE ENGINES;SOLAR HEAT ENGINES

R-10

ACCESSION NO.	80R0017461
TITLE(MONO)	ORGANIC RANKINE CYCLE ENGINE TECHNOLOGY IN JAPAN. A PRELIMINARY SURVEY
CORPORATE AUTH	GALAXY, INC., WASHINGTON, DC (USA)
PAGE NO	132
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT AC03-79SF10538
DATE	OCT 1979
CATEGORIES	EDB-425002
PRIMARY CAT	EDB-425002
REPORT NO	DOE/SF/10538--1
ABSTRACT	THE STATE-OF-THE-ART OF THE DEVELOPMENT OF ORGANIC RANKINE CYCLE ENGINES IN JAPAN IS REVIEWED. (TFD)
DESCRIPTORS	JAPAN;ORGANIC COMPOUNDS;RANKINE CYCLE ENGINES: T1;REVIEWS; TECHNOLOGY ASSESSMENT: Q1;WORKING FLUIDS

R-11

ACCESSION NO.	79C0129695
REPORT NO,PAGE	CONF-790328--P1 PP. 97-105
TITLE	THERMAL STORAGE FOR SOLAR RANKINE AND ABSORPTION COOLING SYSTEMS
AUTHORS	CURRAN, H.M.; HEIBEIN, S.
AUTHOR AFF	HITTMAN ASSOCIATES, INC., COLUMBIA, MD
TITLE(MONO)	PROCEEDINGS OF SOLAR ENERGY STORAGE OPTIONS. VOLUME 1. AN INTENSIVE WORKSHOP ON THERMAL ENERGY STORAGE FOR SOLAR HEATING AND COOLING
PAGE NO	97-105
AVAILABILITY	DEP. NTIS, PC A15/MF A01.
CONF TITLE	SOLAR ENERGY STORAGE OPTIONS WORKSHOP
CONF PLACE	SAN ANTONIO, TX, USA
CONF DATE	18 MAR 1979
DATE	1979
CATEGORIES	EDB-142000;140901;250600;250900
PRIMARY CAT	EDB-142000
REPORT NO	CONF-790328--P1
ABSTRACT	A REVIEW OF THE THERMAL STORAGE ASPECTS OF SOLAR AIR CONDITIONERS INCLUDING RANKINE/VAPOR COMPRESSION CYCLE AND ABSORPTION CYCLE IS GIVEN. SENSIBLE HEAT STORAGE, LATENT HEAT STORAGE, AND THERMOCHEMICAL HEAT STORAGE ARE CONSIDERED. INFORMATION ON THERMAL STORAGE FOR 17 EXISTING SOLAR COOLING INSTALLATIONS IS TABULATED. (WHK)
DESCRIPTORS	ABSORPTION REFRIGERATION CYCLE;HEAT STORAGE;LATENT HEAT STORAGE; RANKINE CYCLE ENGINES;REVIEWS: Q2;SENSIBLE HEAT STORAGE;SOLAR AIR CONDITIONERS: T1;SOLAR HEAT ENGINES;THERMAL ENERGY STORAGE EQUIPMENT: T2,Q1;THERMOCHEMICAL HEAT STORAGE

R-12

ACCESSION NO.	79R0129444
TITLE(MONO)	HANDBOOK OF DATA ON SELECTED ENGINE COMPONENTS FOR SOLAR THERMAL APPLICATIONS
CORPORATE AUTH	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO	NASA-TM--79027
PAGE NO	245
AVAILABILITY	DEP. NTIS, PC A11/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1060
DATE	JUN 1979
CATEGORIES	EDB-140700;200102
PRIMARY CAT	EDB-140700
REPORT NO	DOE/NASA/1060--78/1
ABSTRACT	A SURVEY OF DEVELOPED AND COMMERCIALLY AVAILABLE HEAT-ENGINE COMPONENTS APPLICABLE FOR SOLAR THERMAL POWER SYSTEMS WAS CONDUCTED. THE DATA WERE COMPILED, AND A HANDBOOK WAS PREPARED FOR THE DEPARTMENT OF ENERGY, DIVISION OF CENTRAL SOLAR TECHNOLOGY, BY THE NASA LEWIS RESEARCH CENTER. DESIGN, PERFORMANCE, AND COST DATA WERE PROVIDED BY THE RESPECTIVE MANUFACTURERS ON STEAM TURBINES, RECIPROCATING EXPANSION ENGINES, CONDENSERS, PUMPS, GAS TURBINES, SPEED REDUCERS, AND AC GENERATORS FOR USE IN RANKINE- AND BRAYTON-CYCLE POWER-GENERATING SYSTEMS. COMPONENTS WERE SELECTED FOR SPECIFIC POWER LEVELS FROM 5- TO 50,000-KWE SYSTEM OUTPUT. DEVELOPMENT

STATUS OF THE STIRLING ENGINE IS INCLUDED. THE DATA PRESENTED IN THIS HANDBOOK IDENTIFY COMPONENT DESIGN RANGES AND PERFORMANCE CHARACTERISTICS AT SPECIFIC POWER LEVELS OF DEVELOPED AND COMMERCIALLY AVAILABLE COMPONENTS.

DESCRIPTORS	ALTERNATING CURRENT;BRAYTON CYCLE;BRAYTON CYCLE POWER SYSTEMS: T3;CLOSED-CYCLE SYSTEMS;CONTROL SYSTEMS;COST;DATA;DESIGN; DIAGRAMS;EFFICIENCY;ELECTRIC GENERATORS;GAS COMPRESSORS;GAS TURBINES;MANUALS: Q1,Q2,Q3,Q4;MANUFACTURERS;OPEN-CYCLE SYSTEMS; PERFORMANCE;POWER SYSTEMS: Q5;PUMPS;RANKINE CYCLE;RANKINE CYCLE ENGINES: T2;RANKINE CYCLE POWER SYSTEMS;SOLAR HEAT ENGINES: T1; SOLAR THERMAL POWER PLANTS: T5;SPEED REGULATORS;STEAM TURBINES; STIRLING CYCLE;STIRLING ENGINES: T4;THERMODYNAMICS;VAPOR CONDENSERS

R-13

ACCESSION NO.	79C0122667
TITLE	REVIEW REPORT OF THE SOLAR HEATING/COOLING OPERATIONAL TEST SITE AT STOUFFER PLACE BUILDING NUMBER 1, KANSAS UNIVERSITY, LAWRENCE, KANSAS
AUTHORS	SCARBOROUGH, S.E.); BATTON, W.D.; DOLLARS, B.
AUTHOR AFF	HONEYWELL, INC., MINNEAPOLIS, M
TITLE(MONO)	APPLICATION OF SOLAR ENERGY: 1978
EDITOR OR COMP	WU, S.T.; CHRISTENSEN, D.L.; HEAD, R.R. (EDS.)
SEC REPT NO	CONF-780476--
PAGE NO	269-288
CONF TITLE	3. CONFERENCE ON APPLICATION OF SOLAR ENERGY
CONF PLACE	HUNTSVILLE, AL, USA
CONF DATE	17 APR 1978
PUBL LOC	UNIV. OF ALABAMA, HUNTSVILLE, AL
DATE	1978
CATEGORIES	EDB-140901;140907
PRIMARY CAT	EDB-140901
ABSTRACT	THE MULTIPLE-FAMILY RESIDENTIAL HEATING AND COOLING SYSTEM IS A SINGLE-LOOP, SOLAR-POWERED, TWO-PIPE HYDRONIC HEATING AND COOLING SYSTEM WITH A SEPARATE WATER STORAGE AND DOMESTIC HOT-WATER HEATING LOOP AND LAUNDRY PURGE. THE CENTRAL SYSTEM IS EITHER IN THE HEATING MODE OR THE COOLING MODE AS DETERMINED BY MANUAL SWITCHOVER. THE CENTRAL HEATING IS PROVIDED BY EITHER DIRECT OR STORED SOLAR ENERGY AND THE CENTRAL COOLING IS PROVIDED BY A SOLAR-POWERED RANKINE ENGINE/AUXILIARY ELECTRIC MOTOR-DRIVEN WATER CHILLER. THE SYSTEM PROVIDES THESE 10 MODES OF OPERATION: DIRECT HEATING FROM COLLECTORS; DIRECT HEATING FROM STORAGE; DIRECT HEATING AND STORAGE SIMULTANEOUSLY; AUXILIARY HEATING (INSUFFICIENT SOLAR); RANKINE COOLING FROM COLLECTORS; RANKINE COOLING FROM STORAGE; RANKINE COOLING AND STORAGE SIMULTANEOUSLY; ELECTRIC MOTOR AUXILIARY COOLING; DOMESTIC HOT-WATER PREHEATER; AND PURGE EXCESS ENERGY (FIRST STAGE LAUNDRY, SECOND STAGE FAN COIL). OPERATION AND PERFORMANCE OF THE SYSTEM ARE DISCUSSED.
DESCRIPTORS	APARTMENT BUILDINGS: T1;DATA ACQUISITION;FLAT PLATE COLLECTORS; HEAT PUMPS;HEAT STORAGE;KANSAS;OPERATION;PERFORMANCE: Q2,Q3,Q4; RANKINE CYCLE ENGINES: Q2;SIZE;SOLAR AIR CONDITIONERS: T2;SOLAR AIR CONDITIONING: Q1;SOLAR HEAT ENGINES;SOLAR HEATING SYSTEMS: T3;SOLAR SPACE HEATING: Q1;SOLAR WATER HEATERS: T4;SOLAR WATER HEATING: Q1;SOLAR-ASSISTED HEAT PUMPS;TANKS

R-14

ACCESSION NO. 79C0122686
TITLE SOLAR-POWERED RANKINE HEAT PUMP FOR HEATING AND COOLING
AUTHORS ROUSSEAU, J.
AUTHOR AFF AIRESEARCH MANUFACTURING CO. OF CALIFORNIA, TORRANCE
TITLE(MONO) APPLICATION OF SOLAR ENERGY: 1978
EDITOR OR COMP WU, S.T.; CHRISTENSEN, D.L.; HEAD, R.R. (EDS.)
SEC REPT NO CONF-780476--
PAGE NO 253-267
CONF TITLE 3. CONFERENCE ON APPLICATION OF SOLAR ENERGY
CONF PLACE HUNTSVILLE, AL, USA
CONF DATE 17 APR 1978
PUBL LOC UNIV. OF ALABAMA, HUNTSVILLE, AL
DATE 1978
CATEGORIES EDB-140901
PRIMARY CAT EDB-140901
ABSTRACT IN THE HEATING MODE OF OPERATION, A VAPOR-CYCLE HEAT PUMP USING R-11 AS THE WORKING FLUID PROCESSES SOLAR THERMAL ENERGY COLLECTED AT LOW TEMPERATURE (40$SUP 0$ TO 80$SUP 0$F) TO A TEMPERATURE LEVEL SUITABLE FOR SPACE HEATING. THE HEAT PUMP FEATURES A MOTOR-DRIVEN CENTRIFUGAL COMPRESSOR. BY CONTROLLING THE SPEED OF THE COMPRESSOR SO THAT THE HEAT PUMP CAPACITY MATCHES THE HEAT LOAD, SEASONAL COP'S ON THE ORDER OF 6 CAN BE ACHIEVED. IN THE COOLING MODE OF OPERATION, THE SOLAR THERMAL ENERGY IS USED IN A RANKINE POWER LOOP TO DRIVE THE HEAT PUMP COMPRESSOR. VALVES ARE INCORPORATED IN THE SYSTEM FOR REVERSING THE VAPOR COMPRESSION LOOP FROM THE HEATING TO THE COOLING MODE OF OPERATION. THE THERMAL COP (COOLING LOAD/SOLAR HEAT INPUT) IS ESTIMATED AT ABOUT 0.7. THE OPERATING RANGE OF THE MACHINE IN TERMS OF THE SOLAR HEAT SOURCE TEMPERATURE IS FROM 155$SUP 0$ TO 220$SUP 0$F. THE SYSTEM FEATURES A TURBINE, A COMPRESSOR, AND A PERMANENT MAGNET MOTOR MOUNTED ON THE SAME SHAFT, THUS ELIMINATING THE REQUIREMENTS FOR GEARS. FURTHER, THE ROTOR IS SUPPORTED ON PROCESS FLUID BEARINGS. THE MACHINE IS COMPLETELY HERMETIC, AND NO LUBRICANTS OTHER THAN THE PROCESS FLUID ARE REQUIRED. THIS HERMETIC TURBOCOMPRESSOR/MOTOR IS POWERED IN THE ELECTRICAL MODE BY HIGH-FREQUENCY POWER GENERATED IN A SOLID-STATE CONVERTER FROM UTILITY POWER. BY CONTROLLING THE FREQUENCY OF THE CURRENT FROM THE CONVERTER TO THE MOTOR, VARIABLE SPEED OPERATION IS ACHIEVED. OPERATION AND PERFORMANCE OF THE SYSTEM IS DESCRIBED.
DESCRIPTORS HEAT PUMPS: T3;OPERATION;PERFORMANCE: Q1;RANKINE CYCLE ENGINES: Q2;SOLAR AIR CONDITIONERS: T2;SOLAR AIR CONDITIONING;SOLAR HEAT ENGINES: Q3;SOLAR SPACE HEATING;SOLAR-ASSISTED HEAT PUMPS: T1

R-15

ACCESSION NO. 79R0116252
TITLE(MONO) PERFORMANCE PREDICTION EVALUATION OF CERAMIC MATERIALS IN POINT-FOCUSING SOLAR RECEIVERS
EDITOR OR COMP EWING, J.; ZWISSLER, J.
CORPORATE AUTH JET PROPULSION LAB., PASADENA, CA (USA)
PAGE NO 5
AVAILABILITY DEP. NTIS, PC A04/MF A01.
CONTRACT NO CONTRACT EX-77-A-29-1060
DATE 1 JUN 1979
CATEGORIES EDB-140703;360204
PRIMARY CAT EDB-140703
REPORT NO DOE/JPL--1060-23
ABSTRACT A PERFORMANCE PREDICTION MODEL WAS ADAPTED TO EVALUATE THE USE OF CERAMIC MATERIALS IN SOLAR RECEIVERS FOR POINT-FOCUSING DISTRIBUTED APPLICATIONS. TPS SYSTEM REQUIREMENTS WERE DETERMINED INCLUDING THE RECEIVER OPERATING ENVIRONMENT (SUCH AS CONCENTRATOR PERFORMANCE AND ENVIRONMENT/NATURAL OCCURRENCES) AND SYSTEM OPERATING PARAMETERS FOR VARIOUS ENGINE TYPES. PRELIMINARY RECEIVER DESIGNS EVOLVE FROM THESE SYSTEM REQUIREMENTS. SPECIFIC RECEIVER DESIGNS EVALUATED IN THIS REPORT TO DETERMINE MATERIAL FUNCTIONAL REQUIREMENTS INCLUDE THE NRL SOLCHEM CONVERTER/HEAT EXCHANGER, MIT/LL CERAMIC DOME, BLACK AND VEATCH/EPRI CERAMIC TUBE RECEIVER, AND THE SANDERS HONEYCOMB MATRIX BRAYTON RECEIVER. STATUS OF THE FIRST PHASE OF A CONTINUING TASK OF EVALUATION AND REPORTING ON HIGH TEMPERATURE CERAMICS FOR SOLAR THERMAL RECEIVER APPLICATIONS IS DESCRIBED. SUBSEQUENT REPORTS WILL DEVELOP THE PERFORMANCE PREDICTION MODEL IN MORE DETAIL AND PROVIDE DATA ON ITS USE IN THE SEVERAL HIGH TEMPERATURE RECEIVER AND REACTOR DESIGNS

PLANNED FOR OR UNDER DEVELOPMENT.

DESCRIPTORS: BRAYTON CYCLE;CAVITY RECEIVERS;CERAMICS: T;DISTRIBUTED COLLECTOR POWER PLANTS: T1;EVALUATION;HEAT EXCHANGERS;HONEYCOMB STRUCTURES;MATERIALS: Q2;MATERIALS TESTING;MATHEMATICAL MODELS; PARABOLIC DISH COLLECTORS;PARABOLIC REFLECTORS;PERFORMANCE; RANKINE CYCLE ENGINES;SOLAR RECEIVERS: T2,01;STIRLING ENGINES; TEMPERATURE GRADIENTS;THERMAL CONDUCTIVITY;THERMAL SHOCK; THERMAL STRESSES;TUBES

R-16

ACCESSION NO.: 79C0088121
TITLE: ADVANCED AND DECENTRALIZED INSTALLATIONS FOR COMBINED PRODUCTION OF HEAT AND POWER IN DENSELY POPULATED AREAS
AUTHORS: LEIJENDECKERS, P.H.H.; ENGELS, M.A.; MARTENS, H.
TITLE(MONO): ENERGY USE MANAGEMENT
EDITOR OR COMP: FAZZOLARE, R.; SMITH, C.B. (EDS.)
SEC REPT NO: CONF-771009--P3ANDP4
PAGE NO: 621-630
CONF TITLE: INTERNATIONAL CONFERENCE ON ENERGY USE MANAGEMENT
CONF PLACE: TUCSON, AZ, USA
CONF DATE: 24 OCT 1977
PUBL LOC: PERGAMON PRESS INC., ELMSFORD, NY
DATE: 1978
CATEGORIES: EDB-290600;320603;320101
PRIMARY CAT: EDB-290600
ABSTRACT: IT IS KNOWN THAT EFFICIENT ENERGY CONSUMPTION IS OF UTMOST IMPORTANCE NOW, BOTH FOR THE SHORT- AND MEDIUM-LONG TERM. IN EFFECTUATING A MORE-EFFICIENT CONSUMPTION OF ENERGY THERE ARE TWO IMPORTANT POSSIBILITIES: A DECREASE IN THE ULTIMATE USE OF ENERGY, SUCH AS FOR HEATING, LIGHT, TRANSPORTATION; AND AN IMPROVEMENT IN THE OUTPUT OF THE CONVERSION OF FUELS IN FINAL FUNCTIONS (HEAT, ELECTRICITY), AND AN IMPROVEMENT IN THEIR TRANSPORT. THE FIRST POSSIBILITY WILL TAKE PLACE THROUGH MEASURES TAKEN BY THE FINAL CONSUMERS THEMSELVES. THE SECOND POSSIBILITY REQUIRES TECHNICAL, CIVIL PLANNING, AND MANAGERIAL MEASURES FOR THE ENERGY SUPPLY OF LARGER GROUPS OF CONSUMERS (THE INDUSTRY, URBAN HOUSING AREAS). THIS WILL HAVE CONSEQUENCES FOR THE INFRASTRUCTURAL PROVISIONS WITHIN COMMUNITIES AND FOR SELECTION OF THE TECHNICAL SYSTEMS THAT ARE TO BE EMPLOYED IN THE FUTURE. THIS SECOND CATEGORY IS THE SUBJECT OF THIS PAPER. SOME NEW SYSTEMS FOR A MAXIMUM CONVERSION OF FUELS INTO FINAL ENERGY FUNCTIONS AND COMPONENTS OF THESE SYSTEMS ARE DISCUSSED. IN ORDER TO GET THE MOST-COMPLETE INSIGHT INTO THE ACTUAL FUEL CONSUMPTION AND SAVINGS WITH THE COMBINATION OF TOTAL ENERGY, HEAT PUMP, AND ORGANIC RANKINE CYCLE DESCRIBED, A COMPUTER SIMULATION MODEL WAS DEVELOPED. THE POSSIBILITIES OF SUCH A SYSTEM ARE OFFERED. (MCW)
DESCRIPTORS: CO-GENERATION: T2;COMMUNITIES;CONVERSION;ELECTRIC POWER;ENERGY CONSUMPTION;ENERGY EFFICIENCY;FEASIBILITY STUDIES;HEAT PUMPS; INTERNAL COMBUSTION ENGINES;RANKINE CYCLE ENGINES;RESIDENTIAL SECTOR;SIMULATION;SPACE HEATING;THERMAL EFFICIENCY: Q1,Q2;TOTAL ENERGY SYSTEMS: T1

R-17

ACCESSION NO.: 79R0061284
TITLE(MONO): DEVELOPMENT OF A HIGH TEMPERATURE SOLAR POWERED WATER CHILLER. VOLUME 4. PHASE I TECHNICAL PROGRESS REPORT, SEPTEMBER 26, 1977--JUNE 1, 1978
EDITOR OR COMP: ENGLISH, R.A.
CORPORATE AUTH: CARRIER CORP., SYRACUSE, NY (USA). ENERGY SYSTEMS DIV.
PAGE NO: 150
AVAILABILITY: DEP. NTIS, PC A07/MF A01.
CONTRACT NO: CONTRACT EG-77-C-03-1590
DATE: JUN 1978
CATEGORIES: EDB-140901
PRIMARY CAT: EDB-140901
REPORT NO: SAN--1590-1/4
ABSTRACT: THE PERFORMANCE OF THE HIGH TEMPERATURE SOLAR POWERED WATER CHILLER WAS EVALUATED IN A SOLAR SYSTEM. THREE CLIMATIC REGIONS WERE SELECTED FOR THE EVALUATION WHICH REPRESENT SIGNIFICANT VARIATIONS IN HEATING TO COOLING RATIO. TYPICAL MULTI-FAMILY AND COMMERCIAL BUILDING CONSTRUCTIONS WERE SELECTED FOR EACH LOCATION, AND BUILDING LOAD FILES CREATED USING THE TRNSYS

PROGRAM. SOLAR SYSTEM COMPONENTS WERE SELECTED ON A PRELIMINARY BASIS AND SIMULATION MODELS WERE PREPARED FOR EACH, INCLUDING THE CHILLER. COMPONENT COST AND TOTAL SYSTEM COST DATA WERE DEVELOPED FOR ECONOMIC TRADE-OFF STUDIES. IT IS INTENDED, UNDER THIS CONTRACT, TO EVALUATE VARIOUS SYSTEM CONFIGURATIONS TO DETERMINE WHICH BEST INTERFACES WITH THE SOLAR DRIVEN RANKINE UNIT, BOTH FROM A PERFORMANCE AND ECONOMIC STANDPOINT. PRELIMINARY PARAMETRIC STUDIES WERE BEGUN TO IDENTIFY THE BEST TYPE OF SYSTEM AND BEST COMPONENT SIZING FOR A COMMERCIAL BUILDING IN TWO CITIES. SOME PRELIMANRY ANNUAL PERFORMANCE DATA HAVE BEEN OBTAINED AND RELATED TO CONVENTIONAL EQUIPMENT PERFORMANCE.

DESCRIPTORS: COLD STORAGE;EVALUATION;PERFORMANCE: Q1;RANKINE CYCLE ENGINES: Q1;SENSIBLE HEAT STORAGE;SITE SELECTION;SIZE;SOLAR AIR CONDITIONERS: T1;TANKS;VAPOR COMPRESSION REFRIGERATION CYCLE

R-18

ACCESSION NO.: 7960073297
TITLE(MONO): POWER TECHNOLOGY
EDITOR OR COMP: STEPHENSON, G.E.
PAGE NO: 460
PUBL LOC: DELMAR PUBLISHERS, ALBANY, NY
DATE: 1979
ISBN CODE: ISBN 0-8273-1023-4
CATEGORIES: EDB-330100;330200;200000
PRIMARY CAT: EDB-330100
AUGMENTATION: BOOK
ABSTRACT: POWER TECHNOLOGY INTRODUCES THE STUDENT TO THE BASIC SOURCES OF ENERGY AND HOW PRIME MOVERS OPERATE. IT IS DESIGNED TO MAKE THE STUDENT MORE AWARE OF THE WAY EACH WORKS. IN ADDITION TO REVIEWING THE BASIC PRINCIPLES OF INTERNAL AND EXTERNAL COMBUSTION ENGINES, AND ELECTRIC POWER GENERATION, STORAGE AND TRANSMISSION, THE FOLLOWING NEW TOPICS ARE DISCUSSED: ALTERNATIVE SOURCES OF ENERGY; OVERDRIVE TRANSMISSIONS; TURBOCHARGING; THRUST REVERSING; SPACE SHUTTLE; NUCLEAR FUSION; RECYCLING; IMPROVING AUTOMOBILE ENGINE ECONOMY AND REDUCING POLLUTION; AND OCTANE. THE FINAL SECTION IS DEVOTED TO POWER TECHNOLOGY AND THE ENVIRONMENT. (LCL)
DESCRIPTORS: DIRECT ENERGY CONVERSION;ENERGY CONVERSION: M1;ENERGY SOURCES; ENVIRONMENTAL EFFECTS;INTERNAL COMBUSTION ENGINES: M2; MECHANICAL TRANSMISSIONS;NUCLEAR POWER;OPERATION: Q2;POWER GENERATION;RANKINE CYCLE ENGINES;REVIEWS: Q1;SAFETY;STEAM TURBINES

R-19

ACCESSION NO.: 7900041627
TITLE(MONO): MODELING OF RANKINE CYCLE/VAPOR COMPRESSION CYCLE COOLING SYSTEMS FOR SOLAR ENERGY APPLICATIONS
EDITOR OR COMP: EGRICAN, A.N.
PAGE NO: 219
AVAILABILITY: UNIVERSITY MICROFILMS ORDER NO.7800374.
PUBL LOC: UNIV., OF MARYLAND, COLLEGE PARK, MD
DATE: 1977
THESIS: THESIS (PH. D.)
CATEGORIES: EDB-140901
PRIMARY CAT: EDB-140901
ABSTRACT: AN ORGANIC FLUID RANKINE CYCLE/VAPOR COMPRESSION CYCLE (RC/VCC) COMPUTATIONAL MODEL WAS DEVELOPED FOR USE IN SOLAR COOLING SYSTEM COMPUTER SIMULATIONS. SOLAR COOLING SYSTEM COMPUTER SIMULATIONS ARE UTILIZED IN THE DETERMINATION OF DAILY AND SEASONAL COOLING PERFORMANCE AND IN DETERMINING DESIGN VALUES SUCH AS COOLING CAPACITY, COLLECTOR AREA, STORAGE SIZE, AND SIZES OF PUMPS AND PIPING. RC/VCC SOLAR COOLING SYSTEMS CONVERT COLLECTED SOLAR HEAT INTO A COOLING EFFECT. THIS IS ACCOMPLISHEDAT THE SITE OF THE INSTALLATION BY USING THE RANKINE CYCLE TO GENERATE THE SHAFT WORK REQUIRED TO DRIVE A VAPOR COMPRESSION CYCLE. THE ON-SITE SOLAR POWERED RANKINE CYCLE DIFFERS FROM A CENTRAL STATION RANKINE CYCLE IN THAT THE SOLAR POWERED RANKINE CYCLE OPERATES AT MUCH LOWER BOILER TEMPERATURE CONSISTENT WITH THE USE OF FLAT PLATE OR LOW CONCENTRATION RATIO COLLECTORS. IN THIS STUDY, DESIGN AND OFF-DESIGN TECHNIQUES WERE DEVELOPED WHICH TOOK INTO ACCOUNT HEAT TRANSFER EFFECTS AND ROTATIONAL COMPONENT INEFFICIENCIES.
DESCRIPTORS: BOILERS;COEFFICIENT OF PERFORMANCE;COMPUTER CALCULATIONS;DESIGN;

EFFICIENCY;HEAT TRANSFER;MATHEMATICAL MODELS: Q1,Q2,Q3,Q4; RANKINE CYCLE ENGINES: T2,Q1;SIMULATION;SIZE;SOLAR AIR CONDITIONERS: T1;SOLAR COOLING SYSTEMS;SOLAR HEAT ENGINES: T4; VAPOR COMPRESSION REFRIGERATION CYCLE: T3

R-20

ACCESSION NO.	79C0035336
TITLE	COMMERICAL POTENTIAL OF SOLAR-POWERED IRRIGATION SYSTEMS: A CASE HISTORY
AUTHORS	CONNER, J.G.; HOFMANN, P.L.; HARVEY, T.W.; MCKEON, J.C.
TITLE(MONO)	SOLAR DIVERSIFICATION. VOL. 2.1
EDITOR OR COMP	BOEER, K.W.; FRANTA, G.E. (EDS.)
SEC REPT NO	CONF-780808--P1
PAGE NO	943-946
CONF TITLE	MEETING OF THE AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY
CONF PLACE	DENVER, CO, USA
CONF DATE	28 AUG 1978
PUBL LOC	AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY, INC., NEWARK, DE
DATE	1978
CATEGORIES	EDB-140909;140300
PRIMARY CAT	EDB-140909
ABSTRACT	ACTIVITIES UNDERTAKEN BY THE NORTHWESTERN MUTUAL LIFE INSURANCE COMPANY (NML) AND BATTELLE MEMORIAL INSTITUTE (BMI) DURING 1977 IN ATTEMPTING TO COMMERCIALIZE THE NML/BMI 50 HP SOLAR-POWERED IRRIGATION SYSTEM (SIS) SITED ON THE NML RANCH IN GILA BEND, ARIZONA, ARE OUTLINED. COSTS ASSOCIATED WITH THE GILA BEND UNIT ARE PROVIDED, ALONG WITH EXTRAPOLATIONS OF MANUFACTURING COSTS TO 1000 UNITS. A **BUSINESS MODEL** IS DESCRIBED WHICH WAS DEVELOPED TO PROVIDE AN ECONOMIC FRAMEWORK FOR THE PROPOSED IMPLEMENTATION OF A SIS BUSINESS. USING VARIOUS BASIC BUSINESS ASSUMPTIONS AS INPUT DATA, THE MODEL PERMITS CALCULATION OF THE COMPETITIVE SELLING PRICE OF SOLAR VS ELECTRICALLY POWERED IRRIGATION SYSTEMS AS A FUNCTION OF TIME. CONTACTS WITH POTENTIAL MANUFACTURERS REGARDING COMMERCIALIZATION OF THE SIS VIA A PROPOSED DEMONSTRATION PROGRAM ARE REVIEWED. REASONS GIVEN BY THE COMPANIES FOR NOT PARTICIPATING IN COMMERCIALIZATION EFFORTS TO DATE ARE SUMMARIZED ALONG WITH RECOMMENDATIONS FOR FUTURE ACTIVITIES.
DESCRIPTORS	COMMERCIALIZATION: Q1;COST;ECONOMIC ANALYSIS;ECONOMICS: Q1; IRRIGATION;MANUFACTURING;POWER RANGE 10-100 KW;RANKINE CYCLE ENGINES;RECOMMENDATIONS;SOLAR WATER PUMPS: T1

R-21

ACCESSION NO.	79C0035254
TITLE	SOLAR ENGINE USED TO POWER A 23 TON WATER CHILLER
AUTHORS	BATTON, W.D.; BARBER, R.E.
AUTHOR AFF	BARBER-NICHOLS ENGINEERING CO., ARVADA, CO
TITLE(MONO)	SOLAR DIVERSIFICATION. VOL 2.1
EDITOR OR COMP	BOEER, K.W.; FRANTA, G.E. (EDS.)
SEC REPT NO	CONF-780808--P1
PAGE NO	455-459
CONF TITLE	MEETING OF THE AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY
CONF PLACE	DENVER, CO, USA
CONF DATE	28 AUG 1978
PUBL LOC	AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY, INC., NEWARK, DE
DATE	1978
CATEGORIES	EDB-140901
PRIMARY CAT	EDB-140901
ABSTRACT	A RANKINE ENGINE THAT DRIVES A CONVENTIONAL, HIGH EFFICIENCY 80 KW (23 TON) WATER CHILLER IS DESCRIBED. THE ENGINE OPERATES AT 80$SUP 0$C (176$SUP 0$F) USING FLAT PLATE COLLECTORS. HEAT FROM THE ENGINE IS REJECTED TO A COOLING TOWER. THE RANKINE ENGINE USES R-113 AS A WORKING FLUID, DRIVING A RADIAL INFLOW TURBINE RUNNING AT 24,000 RPM. THE TURBINE SPEED IS REDUCED TO 1200 RPM BY A GEARBOX AND THE OUTPUT POWER IS 14 KW (19 HP). THE OPEN COMPRESSOR IS DRIVEN BY THE GEARBOX THROUGH A CONVENTIONAL ELECTRIC MOTOR WHICH ALSO SUPPLIES AUXILIARY POWER DURING PERIODS OF NO SOLAR ENERGY. THE FIRST SYSTEM HAS BEEN ASSEMBLED AND TESTED. IT WILL BE INSTALLED IN THE FIELD ALONG WITH ADDITIONAL UNITS PRESENTLY BEING ASSEMBLED. THE MEASURED

PERFORMANCE IS BETTER THAN PREDICTED AND IS PRESENTED.

DESCRIPTORS DESIGN: Q2;FLAT PLATE COLLECTORS;HEAT EXCHANGERS;PERFORMANCE: Q2;POWER RANGE 10-100 KW;RANKINE CYCLE ENGINES;REFRIGERANTS; SIZE;SOLAR AIR CONDITIONERS: T1;SOLAR HEAT ENGINES: T2.01

R-22

ACCESSION NO. 79C0024392
TITLE(MONO) SOLAR COOLING R AND D OVERVIEW
EDITOR OR COMP AUH. P.C.
CORPORATE AUTH BROOKHAVEN NATIONAL LAB., UPTON, NY (USA)
SEC REPT NO CONF-760983--4
PAGE NO 4
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT EY-76-C-02-0016
CONF TITLE 3. SOLAR HEATING AND COOLING R AND D BRANCH CONTRACTORS' MEETING
CONF PLACE WASHINGTON, DC, USA
CONF DATE 24 SEP 1976
DATE SEP 1976
CATEGORIES EDB-140901
PRIMARY CAT EDB-140901
REPORT NO BNL--24924
ABSTRACT THE STATUS OF THE PRINCIPAL SOLAR ENERGY CONVERSION PROCESSES FOR COOLING IS REVIEWED; APPLICATIONS READY FOR DEMONSTRATIONS ARE IDENTIFIED; AND DIRECTIONS FOR NEAR TERM R AND D EFFORTS NEEDED TO BRING OTHER POTENTIALLY SUCCESSFUL COOLING SYSTEMS TO THE POINT OF DEMONSTRATION ARE RECOMMENDED. THE PRINCIPAL SOLAR COOLING METHODS ARE CLASSIFIED AS: ABSORPTION, HEAT ENGINE/VAPOR COMPRESSION, DESICCANT, SOLAR ASSISTED HEAT PUMP, PHOTOVOLTAIC HEAT PUMP, AND PASSIVE AND OTHERS.
DESCRIPTORS ABSORPTION REFRIGERATION CYCLE;BNL;DESICCANTS;HEAT PUMPS;POWER SUPPLIES;RANKINE CYCLE ENGINES;RESEARCH PROGRAMS: Q1;REVIEWS; SOLAR AIR CONDITIONERS;SOLAR CELL ARRAYS;SOLAR COOLING SYSTEMS: T1;SOLAR HEAT ENGINES;SOLAR-ASSISTED HEAT PUMPS;US DOE;VAPOR COMPRESSION REFRIGERATION CYCLE

R-23

ACCESSION NO. 79J0020277
TITLE RANKINE COGENERATOR USES WASTE HEAT, SOLAR
PUB DESC ENERGY USER NEWS, V. 3, NO. 38, P. 11
DATE 16 SEP 1976
CATEGORIES EDB-320304;140909;425002
PRIMARY CAT EDB-320304
ABSTRACT AN ADVANCED RANKINE-CYCLE ENGINE WHICH CAN RUN ON EITHER STEAM OR A COMMON REFRIGERANT HAS BEEN INTRODUCED BY SOLAR ENERGY SYSTEMS, INC. THE SMALL THERMAL ENGINES CAN BE POWERED BY RECOVERED WASTE HEAT OR SOLAR ENERGY TO HEAT THE REFRIGERANT. LIGHT INDUSTRIES INVESTING IN THEIR OWN POWER PLANT WILL SPEND ABOUT $30,000 FOR A 25 KILOWATT SYSTEM IF THEY USE FREE WASTE HEAT OR SOLAR ENERGY. A LARGE, TOTAL COMMUNITY CO-GENERATION SYSTEM WILL BE INSTALLED OUTSIDE PHOENIX, ARIZONA. AN EXTENDED PAYBACK PERIOD AND A LACK OF FINANCIAL INCENTIVES ARE THE MAJOR OBSTACLES TO EXPANDING THE MARKET FOR THE SYSTEM.
DESCRIPTORS CO-GENERATION;COST;ENERGY EFFICIENCY;ENERGY RECOVERY;ENGINES; FINANCIAL INCENTIVES;HEAT RECOVERY;INVESTMENT;MARKET: Q1; PAYBACK PERIOD;POWER GENERATION;RANKINE CYCLE ENGINES: T1; REFRIGERANTS

R-24

ACCESSION NO. 79P0013969
PATENT NO US PATENT 4,061,680
TITLE(MONO) MODIFIED RANKINE CYCLE ENGINE APPARATUS
EDITOR OR COMP HALL, C.D.
FILED DATE FILED DATE 26 DEC 1973
PAGE NO 8
DATE 4 OCT 1977
CATEGORIES EDB-425002
PRIMARY CAT EDB-425002
AUGMENTATION PATENT
ABSTRACT A MODIFIED RANKINE CYCLE STEAM ENGINE APPARATUS EMPLOYS A JET PUMP TO WITHDRAW COOLED STEAM FROM AN ADIABATIC EXPANSION ENGINE AND RETURN THE STEAM TO A BOILER FOR REHEATING. THE JET PUMP DRAWS THE EXPANDED, SPENT STEAM FROM THE EXPANSION ENGINE INTO A THROTTLED FLOW OF STEAM PASSING THROUGH THE JET PUMP FROM TWO TAP-OFF POINTS IN THE BOILER.

DESCRIPTORS	DESIGN: Q1;JETS;OPERATION: Q1;RANKINE CYCLE ENGINES: M1;STEAM

R-25

ACCESSION NO. 79R0008561
TITLE(MONO) PHASE I REPORT: SOLAR ASSESSMENT STUDY IN THE SUPPORT OF THE INTERNATIONAL EKISTICS PROGRAM
CORPORATE AUTH LITTLE (ARTHUR D.), INC., CAMBRIDGE, MA (USA)
PAGE NO 258
AVAILABILITY DEP. NTIS, PC A12/MF A01.
CONTRACT NO CONTRACT W-31-109-ENG-38
DATE JUL 1977
CATEGORIES EDB-320603;140000;290000
PRIMARY CAT EDB-320603
REPORT NO ANL/ICES-TM--12
ABSTRACT THE COMMUNITY SYSTEMS BRANCH OF ERDA IS WORKING WITH THE GREEK GOVERNMENT TO DETERMINE HOW BOTH CONVENTIONAL AND RENEWABLE ENERGY SOURCES CAN BE USED TO REDUCE THE CONSUMPTION OF CONVENTIONAL FUELS IN A NEW COMMUNITY BEING PLANNED FOR THE COAST OF CRETE. THE GENERAL PROGRAM APPROACH IS SHOWN SCHEMATICALLY. AVAILABLE CLIMATIC, AND INSOLATION DATA FROM CRETE WERE USED TO MAKE ROUGH ESTIMATES FOR THE HEATING/COOLING LOADS WHICH WILL OCCUR ON INDIVIDUAL BUILDINGS AND FOR THE COMMUNITY AS A WHOLE. THESE DATA WERE CONSIDERED IN PREPARING ''GENERALIZED COMMUNITY ENERGY SYSTEM CONCEPTS'' WITH EMPHASIS PLACED ON SYSTEMS USING RENEWABLE ENERGY SOURCES. THE GENERALIZED ENERGY SYSTEM CONCEPTS WERE PREPARED ONLY IN SUFFICIENT DETAIL AND NUMBERS TO IDENTIFY THE KEY ENERGY SUBSYSTEM WHICH WOULD BE USED AS THE BUILDING BLOCKS FOR MOST OF THE ENERGY SYSTEM CONCEPTS. THE TECHNICAL/COST PERFORMANCE OF SELECTED BASIC ENERGY SUBSYSTEM MODULES USING RENEWABLE ENERGY SOURCES WAS ESTIMATED USING BOTH IN-HOUSE ANALYSIS AND OUTSIDE INFORMATION SOURCES (MANUFACTURERS LITERATURE, ERDA REPORTS, ETC.). THE STATUS OF THE IMPORTANT COMPONENTS (COLLECTORS, ENGINES, STORAGE UNITS, ETC.) COMPRISING THE VARIOUS KEY ENERGY SUBSYSTEMS WAS THEN RE-REVIEWED TO PROVIDE INFORMATION ON COMPONENT OPERATION, PHYSICAL CONFIGURATIONS, COST, AVAILABILITY, MANUFACTURERS, AND MAINTENANCE REQUIREMENTS.
DESCRIPTORS ABSORPTION REFRIGERATION CYCLE;AVAILABILITY;COMPOSTING; CONCENTRATING COLLECTORS;COST;DEHUMIDIFIERS;DESICCANTS;ENERGY SOURCE DEVELOPMENT: Q1;GREECE: T2;GREENHOUSES;HEAT PUMPS;HEAT STORAGE;HEATING LOAD;ICES: T3,Q2;INSULATION;INTERNATIONAL COOPERATION;MAINTENANCE;MANUFACTURERS;PHOTOVOLTAIC POWER PLANTS; PLANNED COMMUNITIES: T1;RANKINE CYCLE ENGINES;REVIEWS;SOLAR CELLS;SOLAR COLLECTORS;SOLAR COOLING SYSTEMS;SOLAR DISTILLATION; SOLAR ENERGY: Q3;SOLAR HEATING SYSTEMS;SOLAR THERMAL POWER PLANTS;WASTE HEAT UTILIZATION;WIND;WIND POWER PLANTS

R-26

ACCESSION NO. 79C0005224
REPORT NO.PAGE CONF-770953 PP. 6.1-6.13
TITLE ACUREX CONCENTRATES ON SOLAR ENERGY
AUTHORS ROSSITER, E.
AUTHOR AFF ACUREX CORP., MOUNTAIN VIEW, CA
TITLE(MONO) SOLAR CONCENTRATING COLLECTORS
PAGE NO 6.1-6.13
CONF TITLE CONCENTRATING SOLAR COLLECTOR CONFERENCE
CONF PLACE ATLANTA, GA, USA
CONF DATE 26 SEP 1977
DATE 1977
CATEGORIES EDB-140909;140905;140300
PRIMARY CAT EDB-140909
REPORT NO CONF-770953--
ABSTRACT SEVERAL THERMAL APPLICATIONS FOR SOLAR SYSTEMS ARE DESCRIBED, INCLUDING IRRIGATION PUMPING, PROCESS HOT WATER, AND PROCESS STEAM. THE DESIGN AND CONSTRUCTION OF THE 25-HP SOLAR IRRIGATION SYSTEM AT WILLARD, NEW MEXICO IS DISCUSSED IN SOME DETAIL. SOME ASPECTS ON THE ECONOMICS AND COSTS FOR SYSTEMS ARE PRESENTED.
DESCRIPTORS COST;ECONOMICS: Q1,Q2,Q3,Q4;IRRIGATION;OPERATION: Q2,Q3; PARABOLIC TROUGH COLLECTORS: T4;RANKINE CYCLE ENGINES;SOLAR PROCESS HEAT: T1;SOLAR WATER HEATERS: T2,Q1;SOLAR WATER PUMPS: T3;STEAM GENERATORS;WELLS

R-27
ACCESSION NO. 79C0005208
TITLE COST EFFECTIVE SOLAR AUGMENTED HEAT PUMP/POWER BUILDING SYSTEMS
AUTHORS MECKLER, M.
AUTHOR AFF ENERGY GROUP, INC., LOS ANGELES
TITLE(MONO) ENVIRONMENTAL TECHNOLOGY '77
SEC REPT NO CONF-770415--
PAGE NO 118-133
CONF TITLE 23. IES ANNUAL TECHNICAL MEETING AND EXPOSITION
CONF PLACE LOS ANGELES, CA, USA
CONF DATE 24 APR 1977
PUBL LOC INSTITUTE OF ENVIRONMENTAL SCIENCES, MT. PROSPECT, IL
DATE 1977
CATEGORIES EDB-140901
PRIMARY CAT EDB-140901
ABSTRACT THE PROBLEM OF INTEGRATION OF SOME PROMISING SOLAR AUGMENTATION CONCEPTS WITH CONVENTIONAL BUILDING HEATING, VENTILATING, AND AIR CONDITIONING AND POWER SYSTEMS IS DISCUSSED. THE FOLLOWING TOPICS ARE DISCUSSED: SOLAR VARIABILITY, THERMODYNAMIC AVAILABILITY, HEAT PUMPS, RANKINE CYCLE ENGINES, CHEMICAL DEHUMIDIFICATION POTENTIALS, OPERATING CYCLES, DYNAMIC STORAGE POTENTIALS, SELECTING SOLAR COLLECTORS FOR POWER OPTIONS, AND SOLAR SYSTEM COSTS AND MARKET PROJECTIONS. (MHR)
DESCRIPTORS AIR CONDITIONING;AVAILABILITY;BUILDINGS;COST;DEHUMIDIFIERS; ECONOMIC ANALYSIS: Q1;FEASIBILITY STUDIES: Q1;HEAT PUMPS; HEATING SYSTEMS;INSULATION;MARKET;RANKINE CYCLE ENGINES;SOLAR COLLECTORS;SOLAR-ASSISTED HEAT PUMPS: T1;VENTILATION

R-28
ACCESSION NO. 76J0128082
TITLE ALTERNATIVE AUTOMOBILE ENGINES
AUTHORS WILSON, D.G.
AUTHOR AFF MASSACHUSETTS INST. OF TECH., CAMBRIDGE
PUB DESC SCI. AM., V. 239, NO. 1, PP. 39-49
DATE JUL 1976
CATEGORIES EDB-330100;330200;298000
PRIMARY CAT EDB-330100
ABSTRACT A TECHNOLOGY ASSESSMENT OF VARIOUS HEAT ENGINES FOR AUTOMOBILE PROPULSION IS PRESENTED COVERING: THE SPARK IGNITION (OTTO) ENGINE; THE COMPRESSION IGNITION (DIESEL) ENGINE; THE VAPOR CYCLE (RANKINE) ENGINE; THE STIRLING ENGINE; AND THE OPEN AND CLOSED BRAYTON CYCLE (GAS TURBINES) ENGINES. COMPARATIVE DATA GIVEN INCLUDE TEMPERATURE RATIO, THERMAL EFFICIENCY, POWER TO MASS RATIO, EXHAUST EMISSIONS, AND MANUFACTURING COST. THE DEFECTS OF ALTERNATIVE ENGINES TO THE SPARK IGNITION ENGINE ARE CLEARER THAN THEIR VIRTUES, AND THE CHOICE OF A SINGLE BEST ALTERNATIVE IS COMPLEX. GOVERNMENT POLICIES WITH RESPECT TO THE AUTOMOTIVE INDUSTRY ARE DISCUSSED. (PMA)
DESCRIPTORS AUTOMOBILES: T1;COST;DIESEL ENGINES;EXHAUST GASES;GAS TURBINES; GOVERNMENT POLICIES;HEAT ENGINES: T2,Q1;POWER;RANKINE CYCLE ENGINES;SPARK IGNITION ENGINES;STIRLING ENGINES;STRATIFIED CHARGE ENGINES;TECHNOLOGY ASSESSMENT: Q2;THERMAL EFFICIENCY; THERMODYNAMICS

R-29	ACCESSION NO.	78R0089101
	TITLE(MONO)	ENGINEERING FEASIBILITY OF A 150-KW IRRIGATION PUMPING PLANT USING SHALLOW SOLAR PONDS
	EDITOR OR COMP	PLATT, E.A.; WOOD, R.L.
	CORPORATE AUTH	CALIFORNIA UNIV., LIVERMORE (USA). LAWRENCE LIVERMORE LAB.
	PAGE NO	26
	AVAILABILITY	DEP. NTIS, PC A03/MF A01.
	CONTRACT NO	CONTRACT W-7405-ENG-48
	DATE	3 APR 1976
	CATEGORIES	EDB-141000;140909
	PRIMARY CAT	EDB-141000
	REPORT NO	UCRL--52397
	ABSTRACT	THE ECONOMICS WAS ANALYZED OF A FIELD OF SHALLOW SOLAR PONDS THAT PRESUMABLY SUPPLIES THE HEAT FOR A RANKINE CYCLE ENGINE USING REFRIGERANT R-113 FOR THE WORKING FLUID. WHEN OPERATING, THE ENGINE SUPPLIES 150 KW OF SHAFT POWER, 125 KW OF THAT IS AVAILABLE FOR DEEP-WELL IRRIGATION PUMPING. THE SYSTEM COMPONENTS HAVE BEEN CHOSEN TO PRODUCE THE MAXIMUM NET ENERGY--APRIL THROUGH OCTOBER--PER DOLLAR OF INSTALLATION COST. WEATHER DATA ARE FROM INYOKERN, CALIFORNIA, 1962 RECORDS FOR MOST CALCULATIONS. IT WAS ESTIMATED THAT, FOR A PRIVATE INVESTOR, THE REAL INTERNAL RATE OF RETURN FOR THIS INSTALLATION WOULD BE POSITIVE ONLY IF IN THE FORSEEABLE FUTURE THE COST OF CONVENTIONAL ENERGY WERE TO INFLATE 8% FASTER THAN THE COST OF THE COMMODITIES NEEDED BY THE SOLAR SYSTEM. A 17% DIFFERENTIAL INFLATION RATE WOULD PRODUCE A 10% RATE OF RETURN. REDUCTION IN COST OF THE SHALLOW SOLAR PONDS POTENTIALLY COULD REDUCE THE SYSTEM INSTALLATION COST BY ABOUT 20%.
	DESCRIPTORS	CALIFORNIA;COST;ECONOMICS;ENGINEERING: Q2;FEASIBILITY STUDIES: Q1,Q2;FREONS;INSTALLATION;IRRIGATION: T3;RANKINE CYCLE ENGINES: Q2;REFRIGERANTS;SOLAR COLLECTORS;SOLAR PONDS: T1;SOLAR WATER PUMPS: T2,Q3;WEATHER;WORKING FLUIDS

R-30	ACCESSION NO.	78J0076408
	TITLE	CURRENT COSTS OF SOLAR POWERED ORGANIC RANKINE CYCLE ENGINES
	AUTHORS	BARBER, R.E.
	AUTHOR AFF	BARBER-NICHOLS ENG CO, ARVADA, COLO
	PUB DESC	SOL. ENERGY, V. 20, NO. 1, PP. 1-6
	DATE	1976
	CATEGORIES	EDB-140700;141000;140909
	PRIMARY CAT	EDB-140700
	ABSTRACT	THIS PAPER ADDRESSES THE TECHNICAL AND COST ASPECTS OF THE ORGANIC RANKINE CYCLE AND ITS INTERACTION WITH THE SOLAR COLLECTOR AS A POWER SYSTEM. THE EFFICIENCY AND PRACTICAL CONSIDERATIONS OF THE COMBINED COLLECTOR AND RANKINE SYSTEM SHOW THAT COLLECTOR TEMPERATURES OF 93$SUP 0$C, 150-200$SUP 0$C, AND 315$SUP 0$C ARE OPTIMUM OPERATING CONDITIONS FOR FLAT PLATE, CONCENTRATORS, AND TRACKING CONCENTRATORS RESPECTIVELY. THE PEAK SOLAR CONVERSION EFFICIENCIES OF THESE SYSTEMS ARE APPROXIMATELY 5, 10 AND 11 PER CENT RESPECTIVELY. IT IS ESTIMATED THAT IN A PRODUCTION UNIT THE RANKINE CYCLE COST WILL BE APPROXIMATELY ONE-THIRD OF THE TOTAL SYSTEM COST WITH TWO-THIRDS GOING TO THE COLLECTOR COMPONENT. CONSEQUENTLY, LOW-COST COLLECTORS ARE CRUCIAL FOR COMMERCIALIZATION OF SOLAR RANKINE SYSTEMS.
	DESCRIPTORS	COMPARATIVE EVALUATIONS;CONCENTRATING COLLECTORS;COST: Q1,Q3; DESIGN: Q1,Q3;ENERGY EFFICIENCY;FLAT PLATE COLLECTORS;HEAT STORAGE;PERFORMANCE;RANKINE CYCLE ENGINES;RANKINE CYCLE POWER SYSTEMS: Q2,T1;REFRIGERANTS;SOLAR CONCENTRATORS;SOLAR ENERGY CONVERSION;SOLAR HEAT ENGINES: T3;SOLAR THERMAL POWER PLANTS: T2;SOLAR TRACKING;TEMPERATURE DEPENDENCE

R-31	ACCESSION NO.	76J0066955
	TITLE	STRETCHING THE GASOLINE GALLON: AN ENGINEERING APPROACH
	AUTHORS	BLAKE, S.E.
	PUB DESC	TRANSP. RES. NEWS, PP. 11-15
	DATE	WIN 1974
	CATEGORIES	EDB-330600
	PRIMARY CAT	EDB-330600
	ABSTRACT	THERE ARE SEVERAL WAYS TO ACHIEVE GREATER EFFICIENCY IN THE USE OF ENERGY FOR TRANSPORTAION; REDUCE DEMAND FOR THOSE SCARCE RESOURCES, SHIFT TRAVEL FROM HIGH-ENERGY MODES SUCH AS THE

	AUTOMOBILE TO MORE ENERGY-EFFICIENT MODES SUCH AS PUBLIC TRANSIT, AND REDUCE ENERGY DEMAND PER VEHICLE-MILE BY MORE ENERGY-EFFICIENT VEHICLES. THREE METHODS ARE DISCUSSED FOR REDUCING ENERGY DEMAND PER VEHICLE-MILE: ENGINE IMPROVEMENTS AND ALTERNATIVES; WEIGHT, SIZE, AND SAFETY FACTORS; AND OTHER DESIGN FEATURES. CHANGES AND IMPROVEMENTS MUST OBVIOUSLY BE MADE IN ENGINE DESIGN, VEHICLE SIZE AND WEIGHT, AND SAFETY TO MEET THE GROWING DEMAND FOR TRANSPORTATION SERVICES AND AT THE SAME TIME ACHIEVE EFFICIENCY IN THE USE OF ENERGY. IF ALL THE AVAILABLE TECHNOLOGY IS APPLIED TO EXISTING PASSENGER VEHICLES, THE SAVINGS COULD BE AS GREAT AS 30% OF THE ESTIMATED 1985 PROJECTED FUEL USE. THIS WOULD SUBSTANTIALLY EXTEND THE SUPPLY OF FOSSIL FUELS.
DESCRIPTORS	AIR POLLUTION CONTROL;AUTOMOBILES: T1;DESIGN: Q1;FUEL ECONOMY: Q1;GAS TURBINES;POLLUTION CONTROL EQUIPMENT;RANKINE CYCLE ENGINES;SAFETY;SIZE;SPARK IGNITION ENGINES;STRATIFIED CHARGE ENGINES;WEIGHT

R-32

ACCESSION NO.	78C0037722
TITLE	ECONOMICS OF RANKINE-CYCLE POWER RECOVERY FROM WASTE PROCESS HEAT
AUTHORS	NULL, H.R.
AUTHOR AFF	MONSANTO CO., ST. LOUIS
TITLE(MONO)	ENERGY USE MANAGEMENT. VOL. 1
EDITOR OR COMP	FAZZOLARE, R.A. (ED.)
PAGE NO	111-116
CONF TITLE	INTERNATIONAL CONFERENCE ON ENERGY USE MANAGEMENT
CONF PLACE	TUCSON, AZ, USA
CONF DATE	24 OCT 1977
PUBL LOC	PERGAMON PRESS INC., ELMSFORD, NY
DATE	1977
DROP NOTE	SEE CONF-771009--P1
CATEGORIES	EDB-320304;290800
PRIMARY CAT	EDB-320304
ABSTRACT	THE ECONOMIC RETURN HAS BEEN DETERMINED FOR POWER RECOVERY VIA RANKINE CYCLE ENGINES FROM WASTE CHEMICAL PROCESS HEAT. A WIDE RANGE OF VARIABLES, SUCH AS POWER COST, WASTE HEAT LOAD, AND TEMPERATURE OF AVAILABLE HEAT HAVE BEEN CONSIDERED. GENERALLY, VERY LARGE WASTE HEAT LOADS ARE REQUIRED FOR PROFITABLE POWER RECOVERY, AND THE TEMPERATURE OF THE AVAILABLE HEAT MUST BE ABOVE 275^{0}F.
DESCRIPTORS	CHEMICAL INDUSTRY: T1;ECONOMICS: Q3;ENERGY CONSERVATION: Q1;HEAT EXCHANGERS;HEAT RECOVERY EQUIPMENT: T3;INDUSTRIAL PLANTS;OPERATION: Q3;PROCESS HEAT;RANKINE CYCLE ENGINES: T2;WASTE HEAT UTILIZATION: Q1,Q2

R-33

ACCESSION NO.	78C0021501
TITLE	ALTERNATIVE POWERPLANTS. (SAE PAPER 730519)
AUTHORS	BROGAN, J.J.
AUTHOR AFF	ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC
TITLE(MONO)	ENERGY AND THE AUTOMOBILE
PAGE NO	31-36
CONF TITLE	ENERGY AND THE AUTOMOBILE FORUM
CONF PLACE	DETROIT, MI, USA
CONF DATE	15 MAY 1973
PUBL LOC	SOCIETY OF AUTOMOTIVE ENGINEERS, WARRENDALE, PA
DATE	1973
DROP NOTE	SEE CONF-730534--
CATEGORIES	EDB-330100;330200;320203
PRIMARY CAT	EDB-330100
ABSTRACT	A REVIEW IS MADE OF AVAILABLE DATA ON FUEL ECONOMIES OF THE CURRENT INTERNAL COMBUSTION ENGINE-POWERED AUTOMOBILES AND OF THOSE WITH ALTERNATIVE POWERPLANTS. COMPARISONS OF FUEL ECONOMIES OF ALL THESE ENGINE SYSTEMS ARE MADE ON THE BASIS OF THE VEHICLE WEIGHT/ENGINE DISPLACEMENT, AND THE VEHICLE WEIGHT ALONE. THE THERMAL EFFICIENCIES ARE ALSO COMPARED. IT IS SHOWN THAT SEVERAL VERSIONS OF THE DIESEL ENGINE WHICH MEET THE 1975 CLEAN AIR ACT STANDARDS AND WHICH ARE ON THE ROAD TODAY ARE MORE EFFICIENT THAN THE CONVENTIONAL INTERNAL COMBUSTION ENGINE OF 1973. MOREOVER, PROTOTYPES OF OTHER ALTERNATIVE SYSTEMS, USING OTHER CYCLES (BRAYTON, RANKINE, STIRLING) UNDER DEVELOPMENT ARE ALSO PROJECTED TO PROVIDE HIGHER EFFICIENCIES

THAN THE CONVENTIONAL INTERNAL COMBUSTION ENGINE OF 1973. ALL COMPARISONS ARE MADE USING THE FEDERAL DRIVING CYCLE AS A COMMON REFERENCE.

DESCRIPTORS AUTOMOBILES: T1;CLEAN AIR ACT;COMPARATIVE EVALUATIONS;DIESEL ENGINES;ENGINES: Q1;FEDERAL TEST PROCEDURE;FUEL ECONOMY;GAS TURBINES;INTERNAL COMBUSTION ENGINES;RANKINE CYCLE ENGINES;SIZE; SPARK IGNITION ENGINES;STIRLING ENGINES;THERMAL EFFICIENCY; WANKEL ENGINES;WEIGHT

R-34

ACCESSION NO. 78R0004269

TITLE(MONO) GOALS AND GUIDELINES: RANKINE CYCLE PROPULSION SYSTEMS FOR APPLICATION TO URBAN BUSES AND OTHER HEAVY-DUTY VEHICLES

EDITOR OR COMP RENNER, R.A.

CORPORATE AUTH INTERNATIONAL RESEARCH AND TECHNOLOGY CORP., WASHINGTON, D.C. (USA)

SEC REPT NO IRT--301-R; UMTA-CA--06-0031-72-3

PAGE NO 28

AVAILABILITY NTIS $3.00.

DATE 1 DEC 1972

CATEGORIES EDB-330202;330603

PRIMARY CAT EDB-330202

REPORT NO PB--218143

ABSTRACT PRELIMINARY GOALS AND GUIDELINES ARE PRESENTED FOR THE DEVELOPMENT OF LOW-EMISSION RANKINE CYCLE ENGINE (RCE) EXTERNAL COMBUSTION PROPULSION SYSTEMS FOR URBAN TRANSIT VEHICLES. BOTH INTERIM AND LONG-RANGE GOALS FOR POWER SYSTEMS ARE DESCRIBED. SO THAT DEVELOPMENT CAN PROGRESS TOWARD PROTOTYPES HAVING PROPERTIES ACCEPTABLE TO FLEET OPERATORS. UNDER THE CALIFORNIA STEAM BUS PROJECT, THREE CONVENTIONAL 40-FOOT TRANSIT BUSES WERE CONVERTED TO RCE POWER. OPERATIONAL TESTING DEMONSTRATED LOW EXHAUST EMISSIONS AND REDUCED NOISE LEVELS, BUT BOTH WERE JUDGED CAPABLE OF FURTHER IMPROVEMENT. ROAD PERFORMANCE WAS COMPETITIVE WITH CONVENTIONAL DIESEL PROPULSION. THE PURPOSE OF THE GUIDELINES PRESENTED IS TO ADDRESS SEVERAL OF THE PARTICULAR AREAS NEEDING IMPROVEMENT. EMPHASIS IS GIVEN TO THE NEED FOR BETTER FUEL ECONOMY, SYSTEM RELIABILITY, AND ECONOMICAL PRODUCTION. THE GENERAL GUIDELINES COVER ONLY RCE POWER PLANTS, ALTHOUGH GUIDELINES FOR OTHER EXTERNAL COMBUSTION SYSTEMS ARE RECOMMENDED. PRINCIPAL AREAS COVERED IN THE REPORT INCLUDE: (1) A DESCRIPTION OF THE BUS AND ITS CHARACTERISTICS; (2) GENERAL POWER SYSTEM REQUIREMENTS; (3) PERFORMANCE CRITERIA; (4) FUELS AND FUEL ECONOMY; (5) OBJECTIVES FOR REDUCTION OF EMISSIONS, NOISE, AND HEAT RELEASE; (6) OPERATIONAL SAFETY; (7) OPERATING CHARACTERISTICS; (8) RELIABILITY AND MAINTENANCE FACTORS; (9) RESOURCES AND MATERIALS UTILIZATION; (10) PRODUCTION CONSIDERATIONS; (11) COST PROJECTIONS; AND (12) APPLICATIONS.

DESCRIPTORS AUTOMOTIVE FUELS;BUSES: T1;COST;DESIGN: Q3;ECONOMICS;EXHAUST GASES;FUEL ECONOMY;MAINTENANCE;MATERIALS;NOISE;OPERATION; PERFORMANCE;PRODUCTION;RANKINE CYCLE ENGINES: T3,Q1,Q2; RECOMMENDATIONS;RELIABILITY;SAFETY;THERMAL EFFLUENTS;USES; VEHICLES: T2

R-35

ACCESSION NO. 78R0004275

TITLE(MONO) TRANSIT BUS PROPULSION SYSTEMS STATE-OF-THE-ART. FINAL REPORT

CORPORATE AUTH BOOZ-ALLEN APPLIED RESEARCH, INC., BETHESDA, MD. (USA)

SEC REPT NO UMTA-IT--06-0025-72

PAGE NO 89

AVAILABILITY NTIS.

DATE AUG 1972

CATEGORIES EDB-330100;330200;330600;330700

PRIMARY CAT EDB-330100

REPORT NO PB--226671

ABSTRACT THE PRESENT STATE-OF-THE-ART OF PROPULSION TECHNOLOGY APPLICABLE TO THE 40-FOOT TRANSIT BUS IS REVIEWED. THE APPLICABLE PROGRAM, TRANSBUS, UTILIZES THE BEST AVAILABLE COMPONENTS AND TECHNOLOGY TO IMPROVE THE PERFORMANCE, SUITABILITY AND PUBLIC ACCEPTABILITY OF THE MOTOR COACH FOR URBAN MASS TRANSPORTATION. MAJOR COVERAGE IS GIVEN TO DIESEL AND GAS TURBINE ENGINES. CLOSED-CYCLE ENGINES SUCH AS RANKINE AND STIRLING ENGINES ARE ALSO COVERED. POWER, WEIGHT, COST, AND ENVIRONMENTAL CONSIDERATIONS, AS WELL AS TRANSMISSION AND POWER MANAGEMENT; ARE DISCUSSED.

DESCRIPTORS BUSES: T1;CONTROL SYSTEMS;COST;DIESEL ENGINES;EXHAUST GASES: Q1; FUEL CONSUMPTION;GAS TURBINES;MECHANICAL TRANSMISSIONS;POWER; PROPULSION: Q1;RANKINE CYCLE ENGINES;SPARK IGNITION ENGINES; STIRLING ENGINES;TECHNOLOGY ASSESSMENT;WEIGHT

R-36

ACCESSION NO.	78C0001791
TITLE	PERFORMANCE OF SOLAR SOURCE RANKINE CYCLE ENGINE COOLING SYSTEMS
AUTHORS	OLSON, T.J.; BEEKMAN, D.M.; BECKMAN, W.A.; MITCHELL, J.W.
AUTHOR AFF	UNIV. OF WISCONSIN, MADISON
TITLE(MONO)	PROCEEDINGS OF THE 1977 ANNUAL MEETING OF THE AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY. VOLUME 1. SECTIONS 1--13
EDITOR OR COMP	BEACH, C.; FORDYCE, E. (EDS.)
PAGE NO	7.15-7.19
CONF TITLE	SOLAR WORLD MEETING
CONF PLACE	ORLANDO, FLORIDA, USA
CONF DATE	6 JUN 1977
PUBL LOC	AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY, CAPE CANAVERAL, FL
DATE	1977
DHOP NOTE	SEE CONF-770603--P1
CATEGORIES	EDB-140901
PRIMARY CAT	EDB-140901
ABSTRACT	LONG TERM RANKINE ENGINE-SOLAR COOLING SYSTEM PERFORMANCE FOR RESIDENTIAL COOLING IS SIMULATED IN ALBUQUERQUE, NEW MEXICO AND MIAMI, FLORIDA. FOR A FIXED COLLECTOR AREA, THERE IS AN OPTIMAL ENGINE SIZE WHICH WILL PROVIDE THE GREATEST FRACTION OF THE COOLING LOAD FROM SOLAR ENERGY, BUT LESS POWER THAN THAT REQUIRED TO MEET A DESIGN DAY LOAD. SIZING TO MEET THE DESIGN DAY LOAD YIELDS POOR RANKINE ENGINE PERFORMANCE AT OFF DESIGN CONDITIONS DURING MOST OF THE SEASON. THERE IS AN OPTIMAL STORAGE SIZE THAT IS LESS THAN THAT RECOMMENDED FOR HEATING SYSTEMS. AN ECONOMIC STUDY SHOWS THAT THE RANKINE ENGINE-SOLAR COOLING SYSTEM STUDIED HERE IS NOT COST EFFECTIVE IN EITHER OF THE LOCATIONS CHOSEN.
DESCRIPTORS	COOLING LOAD;ECONOMICS;FLORIDA;MATHEMATICAL MODELS: Q1;NEW MEXICO;PERFORMANCE: Q1;RANKINE CYCLE ENGINES;SIZE;SOLAR AIR CONDITIONERS: T1;SOLAR COOLING SYSTEMS

R.37 "Advanced Types of Generation for Smaller Utility Systems", Peter Steitz and Gayle Mayo. Public Power, March/April 19.

R.38 "Organic Rankine Cycles for the Petro-chemical Industry", R.K. Rose and D.D. Colasimo, Mechanical Technology, Inc.

R.39 "Diesel Organic Rankine Cycle Compound Engine (Bottoming Cycle) Program Plan Nov. 1978. Report No. DOE/CS-0052.

R.40 "Design Study of a Two-Phase Turbine Bottoming Cycle", W.R. Studhalter, DOE/ET15350-T1 June 1979.

R.41 Private communication with J.P. Abbin, Sandia Laboratories, Albuquerque, New Mexico.

R.42 "Sandia Laboratories Operational Experience with Small Heat Engines in Solar Thermal Power Systems", J.P. Abbin, Jr. Proceedings of the 14th IECEC Conference, Aug. 1979, pp. 143-147.

R.43 "Description and Test Results for a Low Temperature 3kWe Rankine Cycle Energy Conversion System", J.P. Abbin, Jr., Sandia Laboratories, SAND 77-1538, 1978.

R.44 Private communication with Doug Lacey, Sunstrand Corp., Rockford, Illinois, Jan. 1981.

FUEL CELL ENERGY CONVERSION SYSTEMS

Analysis

Phosphoric Acid Fuel Cell

Enough quantitative information was gathered on this system, which is the most advanced fuel cell system, to allow the determination of the functional dependence on the system size of each of the following parameters: efficiency, volume, acquisition cost, and operation and maintenance cost (excluding the cost of fuel). The data sets used in the analysis for these parameters are summarized in Table 26.

Applying the least squares analysis technique to these data sets resulted in the following functions relating the system's size and these parameters.

PAFC Efficiency (PFCEF), %

$$PFCEF = 37.784 + 1.769 \log x \qquad (24)$$

Where x = size in kW

Standard Deviation = 2%

PAFC Stack Acquisition Cost (PFCTC), \$/kW

$$PFCSC = 508.90\ x^{-0.3063} \qquad (25)$$

Standard Deviation = \$63.17

PAFC Total Installed Plant Acquisition Cost (PFCTC), \$/kW

$$PFCTC = 752.40 - 101.233 \log x \qquad (26)$$

Standard Deviation = 183.60

It can also be correlated by the following function:

$$PFCTC = 835.75\ x^{-0.0929} \qquad (27)$$

Standard Deviation = 14.57

PAFC Operation and Maintenance Cost, \$/kWhr

The data available in literature on the operation and maintenance cost of PAFC's are scattered over the range of 0.001 to about 0.006 \$/kWhr, with most of the values falling around \$0.004/kWhr. The average of the most probable values is found to be \$0.00387/kWhr, i.e. —

$$PFCOM = 0.00387 \qquad (28)$$

Standard Deviation = 0.000861

Table 26. DATA USED IN THE STATISTICAL ANALYSIS FOR PARAMETERS OF EFFICIENCY, VOLUME, ACQUISITION COST, AND OPERATIONS AND MAINTENANCE COST OF THE PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM

System Size (kW)	System Efficiency	Volume (ft^3/kW)	Acquisition Cost ($/kW)		O&M Cost ($/kWHr)
			Stack Only	Total System	
5	0.379		359		
10	0.409		359		
15		1.21, 1.47, 2.21			
25			283, 132	634	0.00440, 0.00199
40	0.400, 0.400		456, 129	604, 1240, 573	
60	0.420	0.73, 1.24	89, 90		
100			129	525	
250			129, 129	509, 509	
4800				598	0.0046
5000	0.468				0.00403, 0.0105
10,000	0.411			580	0.00403
25,000	0.468				0.00403

Equations 24 through 28 and the appropriate input data are plotted in Figures 21 through 25, respectively. Results obtained from these equations at certain kW sizes are shown in Table 27.

PAFC Weight

Because of the modularity of PAFC's, its weight is not expected to be size dependent. Our literature search showed that for pressurized methanol fueled cells the expected weight is about 22 lb/kW. For pressurized propane fueled systems, the expected weight is about 28 lb/kW. Overall system weight of about 80 lb/kW is expected excluding the fuel storage facilities.

PAFC Volume

Literature on the volume of PAFC system is scarce. It is estimated that for automobile applications, the volume occupied by methanol fueled PAFC systems is about 1.47 ft^3/kW for 15 kW, respectively. These values include all fuel storage accessories.

The footprint of a 26-MW PAFC plant is expected to be about 0.58 ft^2/kW.

PAFC Start-Up and Shutdown Times

The expected start-up time of a PAFC system from an idle position to full load is about 10-15 minutes. Start-up time from a cold start to full load is expected to be about 4 hours. The start-up times are dependent to some extent on the type of fuel and fuel processor used.

The shutdown times are expected to be analogous to the start-up times.

Lifetime

No commercial fuel cells are in operation nowadays. Therefore only estimates of the lifetime of these systems exist. This is not just for the fuel cell stack but also for other parts of the system which are commercially available because of the harsh environment to which they may be exposed, such as the carryover of the acid into the heat exchangers where it will have severe corrosion effects. However, there is a good agreement among the estimates, which are summarized below:

Fuel Cell Stack	=	40,000 hrs of operation
Total System	=	160,000 hrs with fuel cell replacements

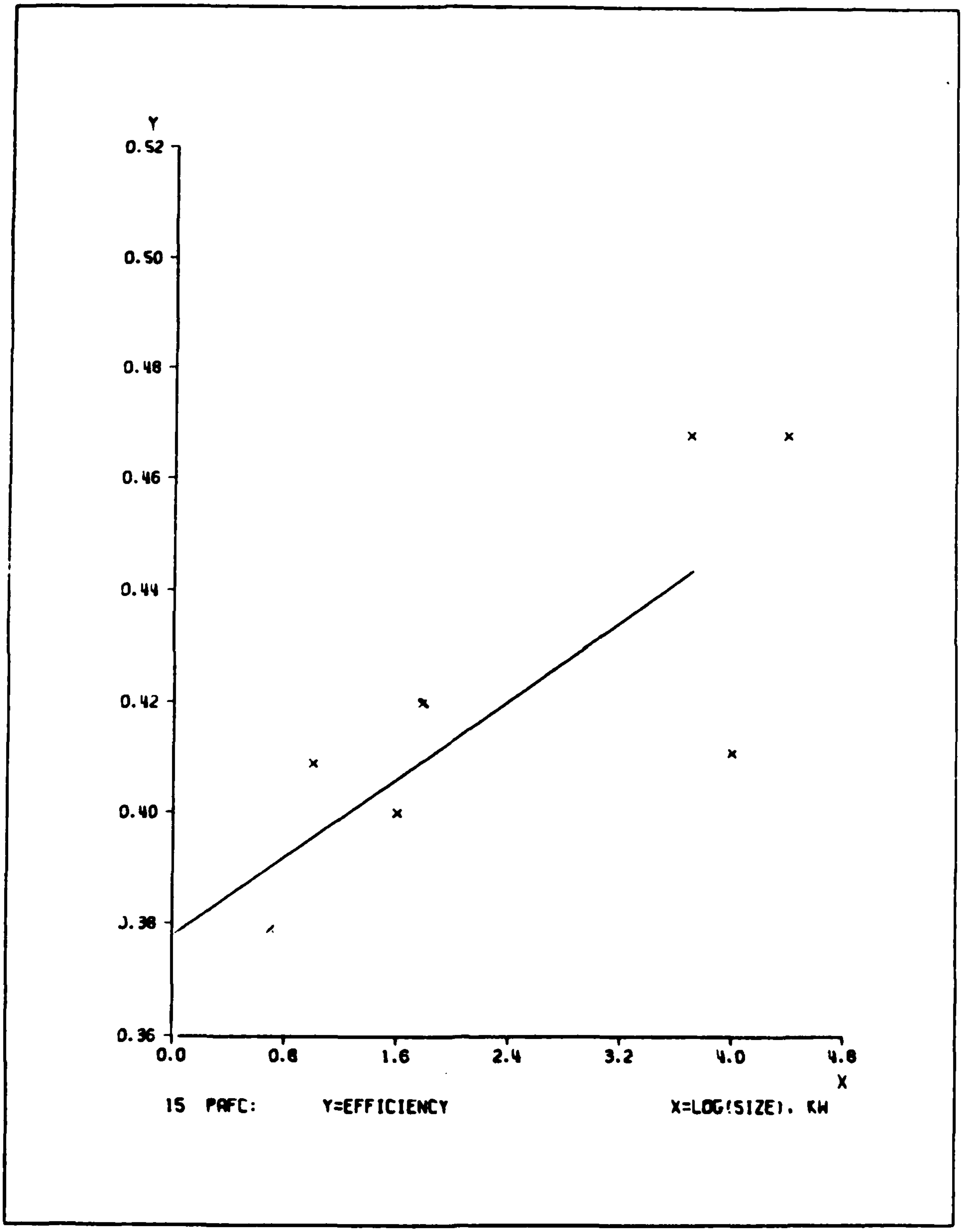

Figure 21. PHOSPHORIC ACID FUEL CELL EFFICIENCY VERSUS SIZE

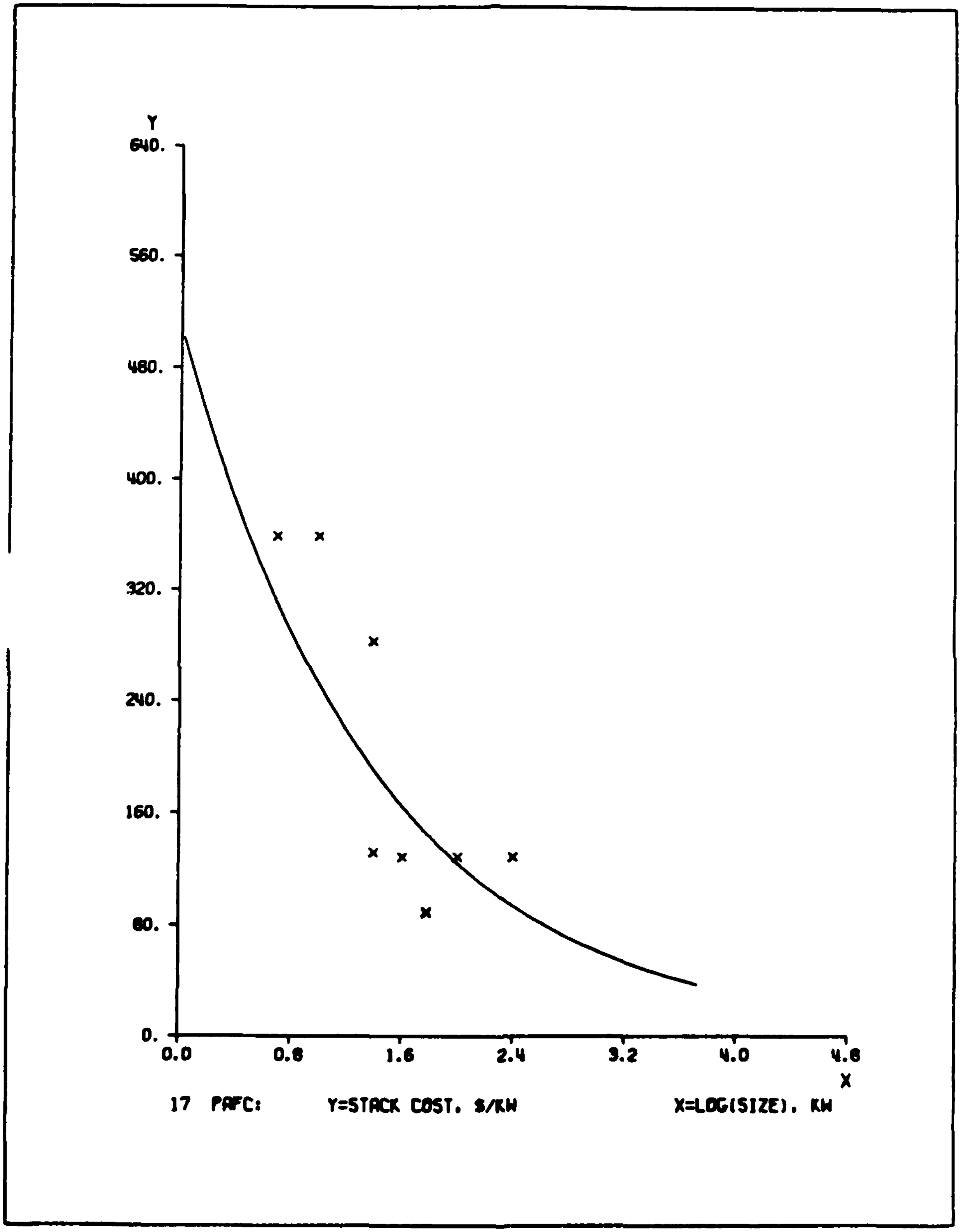

Figure 22. **PHOSPHORIC ACID FUEL CELL STACK ACQUISITION COST VERSUS SIZE**

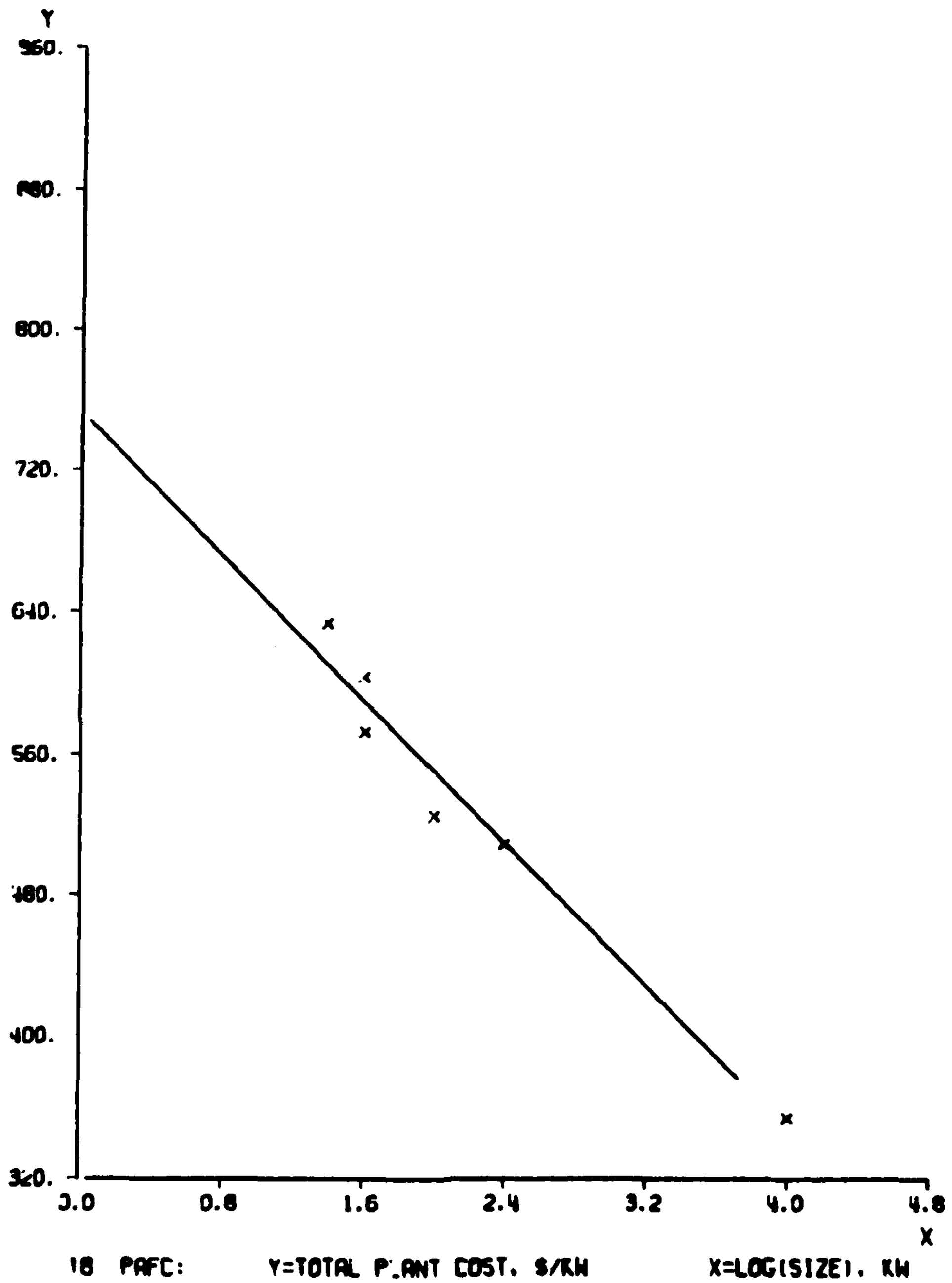

Figure 23. PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM INSTALLED PLANT COST VERSUS SIZE

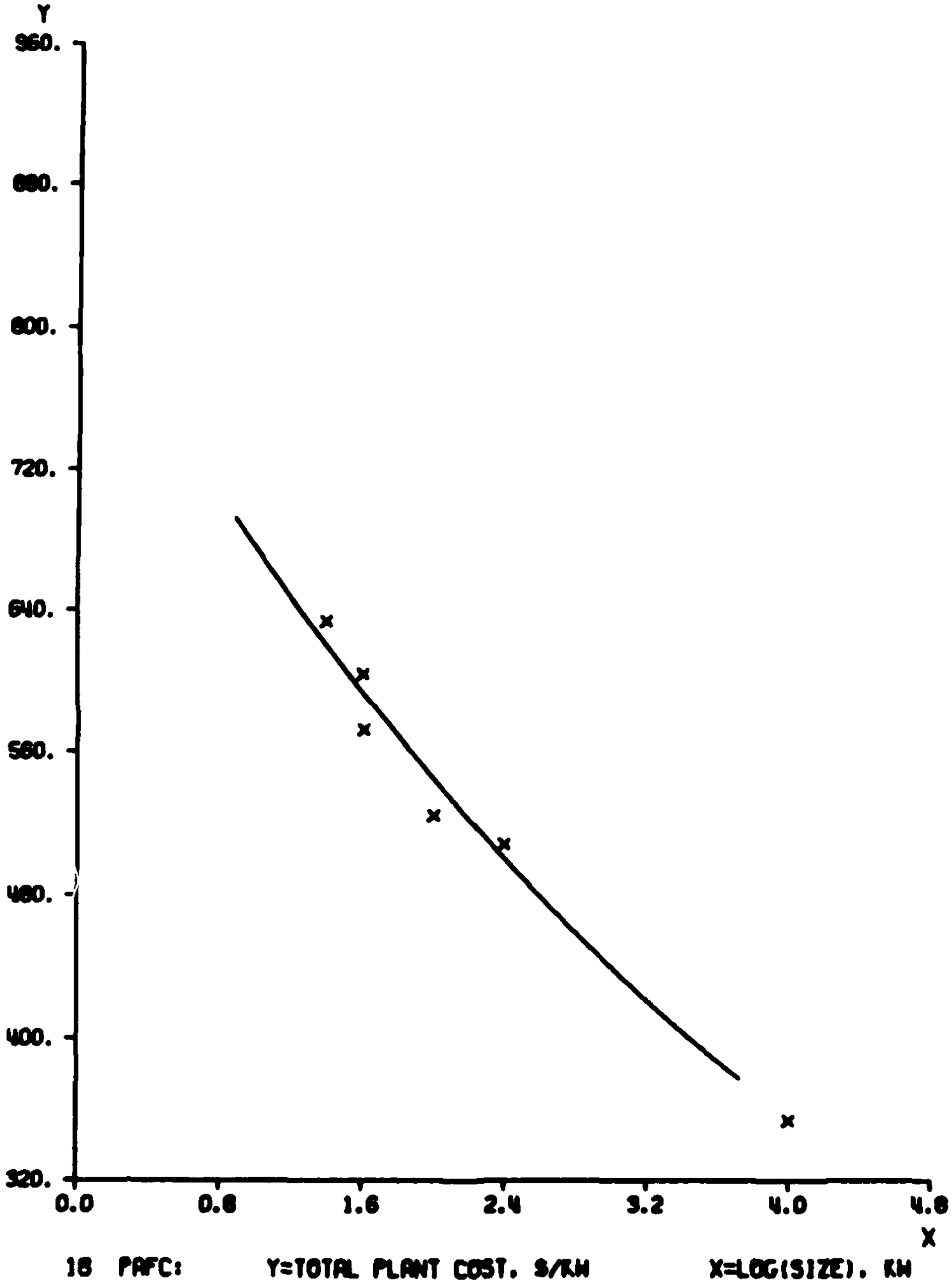

Figure 24. PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM INSTALLED PLANT COST VERSUS SIZE

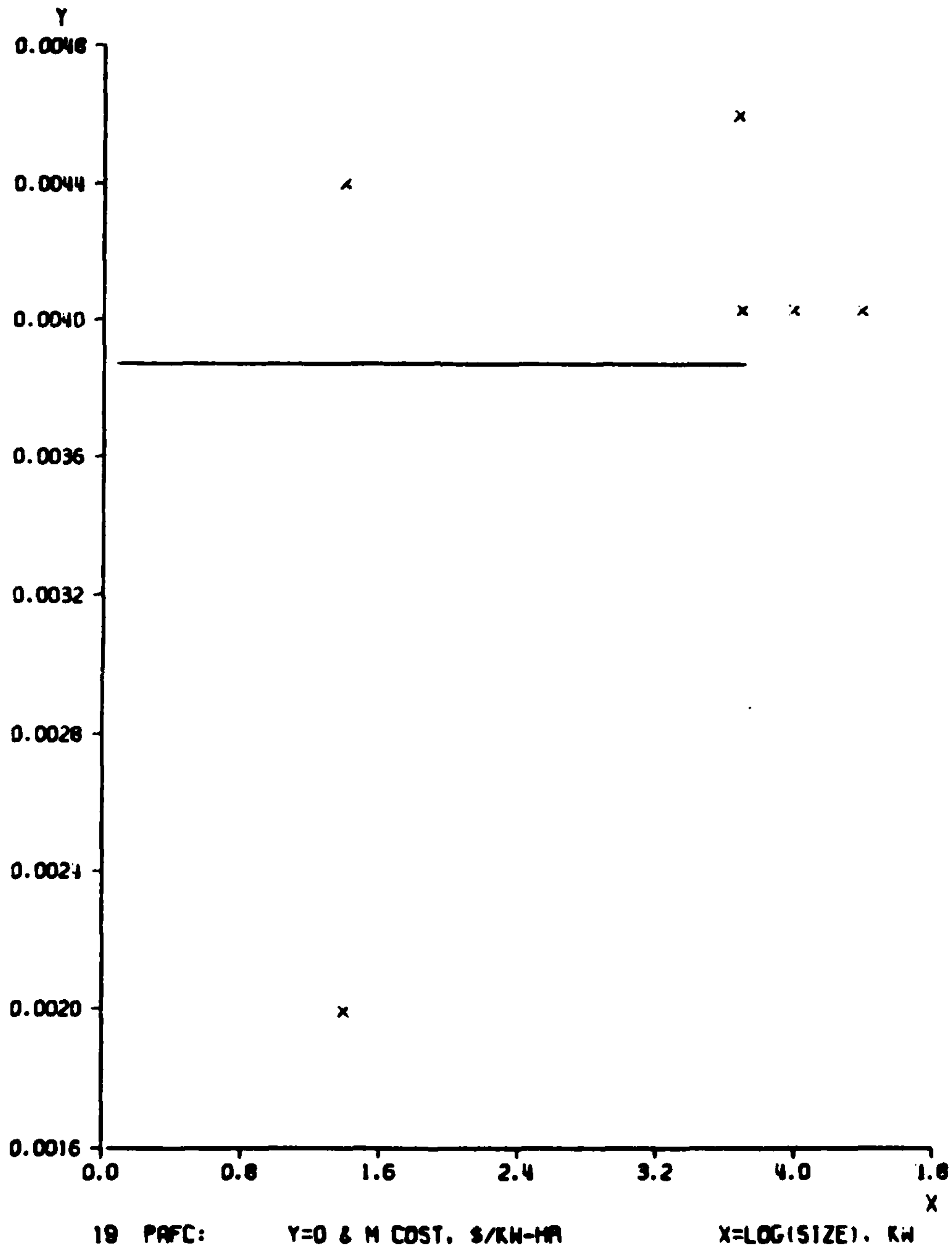

Figure 25. PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM OPERATION AND MAINTENANCE COST VERSUS SIZE

Table 27. VALUES OF THE PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

Size, kW	(Equation 24) Efficiency ± 2%	(Equation 25) PAFC Stack Cost $/KW, ± 63.17	(Equation 26) PAFC System Total Cost $/KW, ± 183.60	(Equation 27) PAFC System Total Cost $/kW, ± 14.57	(Equation 28) O&M Cost, $/kWHr (Excluding Fuel Cost)
1.5	38.1	449	735	805	0.004
5.0	39.0	311	682	720	0.004
20.0	40.1	203	621	633	0.004
30.0	40.4	180	603	609	0.004
60.0	40.9	145	572	571	0.004
100.0	41.3	124	550	545	0.004
250.0	42.0	94	510	500	0.004
750.0	42.9	67	461	452	0.004
1000.0	43.1	61	449	440	0.004
5000.0	44.3	37	378	379	0.004
10,000.0	44.9	30	347	355	0.004

Mobility

The larger the system the more difficult it is to move. Systems of about 1 MW and larger in size are not mobile and not transportable. Only units of several kilowatts are mobile.

Other Energy Production

Thermal energy is available from the fuel processor, and from the fuel cell stack and its exhaust streams. The quality of the heat available from the fuel processor depends on the type of fuel and processing method. The heat available from the fuel cell and its exhaust streams may be used to produce hot water and low pressure steam.

Availability of Raw Material

The phosphoric acid cell uses platinum as a catalytic electrode coating. Platinum is expensive, not abundant, and is dependent on foreign sources.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 28, 29, 30, and 31, respectively.

Table 28. PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM LOCATION CONSTRAINTS

Constraint	Effect	Remarks
1. Water Requirements	---	No water required, it is the final product of the electrochemical reaction
2. Manning Requirements	---	Fully automated
3. Fuel Availability	●	Most systems will utilize naphtha and/or natural gas. It could also utilize coal derived gases
4. Fuel Storage	O	Especially in remote areas where gas pipelines are not available
7. Other	O	Metropolitan siting could be limited by fuel processor

Overall Assessment: The ordinal score is 3 indicating average turn-down capability.

75(3)/RPE/61045Q

Table 29. PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM OPERATION CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability and Efficiency	O	Efficiency not affected by part-load
2. Overload Capability	●	Fuel Cells have very limited overload capability
3. Load Following Capability	O	

Overall Assessment: The ordinal score is 3 indicating average turn-down capability.

75(3)/RPE/61045Q

Table 30. PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM RELIABILITY

Constraint	Effect	Remarks
1. Moving Parts	--	No effect
2. Operating Temperature	0	375°F (stack), 1000° to 2000°F (fuel processor)
3. Modularity of Design	0	Only certain sizes may be available for fuel processor
4. Stress Levels	0	Minor
5. Corrosion	0	Mainly due to acid carryover
6. Other	●	Platinum coated electrodes are poisoned by concentrations of CO exceeding 1% in feedstream

Overall Assessment: The ordinal score is 4 indicating moderate reliability.

69(3)/toc/ER

Table 31. PHOSPHORIC ACID FUEL CELL ENERGY CONVERSION SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	●	—	—	Could be utilized in cogenerative mode
• Air Pollution				
CO	—	—	—	CO is treated in a shift reactor because it poisons the Platinum coated electrodes
NO_x	—	—	—	Low temperature operation and no combustion
SO_x	—	—	—	Fuel is desulfurized before processing because it poisons catalysts
HC	—	—	—	HC's are processed to produce H_2
Others	—	—	—	No combustion and no solid products are allowed in the system
• Noise	O	O	◐	
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

75(3)/RPE/61045Q

Solid Polymer Electrolyte (SPE) Fuel Cell

Quantitative data on solid polymer electrolyte (SPE) fuel cells are scarce and most of the data available are time and application dependent. For instance the projected cost of these cells is only a small fraction of the actual cost of the units in the 1960's in spaceships. Further, this type of fuel cells is not as actively pursued nowadays as the phosphoric acid and molten carbonate fuel cell systems. However, enough data were gathered to allow preliminary statistical analysis of the cost of the SPE fuel cell stack and that of the total system. The data used in the analysis are shown in Table 32.

Table 32. DATA FOR SOLID POLYMER ELECTROLYE FUEL CELL ENERGY CONVERSION SYSTEM STACK COST AND TOTAL SYSTEM COST

Size (kW)	Fuel Cell Stack Cost ($/kW)	Total System Cost ($/kW)
2	318	--
5	165, 212	--
10	118	870
25	74, 61, 62, 50, 40, 42	--
30	47	--
25,000		343
900,000		343

Applying the least squares analysis technique to these data sets resulted in the following functions relating the system's size and these two parameters.

SPE Fuel Cell Stack Cost (SPSC), $/kW

$$SPSC = 585.14\ x^{-0.7385} \tag{29}$$

Where x is the size in kW

Standard Deviation = $19.37/kW

This function is not recommended for extrapolation to sizes larger than about 250 kW because it predicts low values compared to the standard deviation associated with them. Further, at sizes above 100 kW the standard deviation should be taken as +19.37 because the negative value will result in a negative cost of the stack, which is impossible.

SPE Fuel Cell Total System Cost (SPTC), $/kW

$$SPTC = 1004.06\ x^{-0.08766} \tag{30}$$

Standard Deviation = $92.27/kW

Equations 29 and 30 are plotted in Figures 26 and 27, respectively. Predicted values based on these two equations are shown in Table 33 at the desired kW sizes.

Table 33. VALUES OF THE SOLID POLYMER ELECTROLYTE FUEL CELL ENERGY CONVERSION SYSTEM PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

Size (kW)	(Equation 29) Stack Acquisition Cost, $/kW ± 19.37	(Equation 30) System Acquisition Cost, $/kW ± 92.27
1.5	433.7	969.0
5.0	178.3	871.9
20.0	64.0	772.2
30.0	47.5	745.2
60.0	28.5	701.3
100.0	19.5	670.6
250.0	9.9*	618.8
750.0	4.4*	562.0
1000.0	3.6*	548.0
5000.0	1.1*	476.0

* Predicted values are smaller than the deviation associated with the fit. Consequently such extrapolation should be handled carefully.

Lifetime

A lifetime in excess of 50,000 hours operation is possible for the fuel cell stack. This is due primarily to the low operating temperatures of the cells (below 100°C).

Mobility

The larger the system the more difficult it is to move or transport. Units smaller than about 25 kW can be made modular. Units of sizes up to 1 MW may be transported.

Other Energy Production

These systems operate at temperatures below 100°C; therefore only hot water may be produced using the available heat. Higher grade heat may be available from the fuel process section. Its quantity and quality depends on the type of fuel used and on the processing method.

Availability of Raw Material

Because this system operates at low temperatures it does not suffer from severe temperature-related material problems.

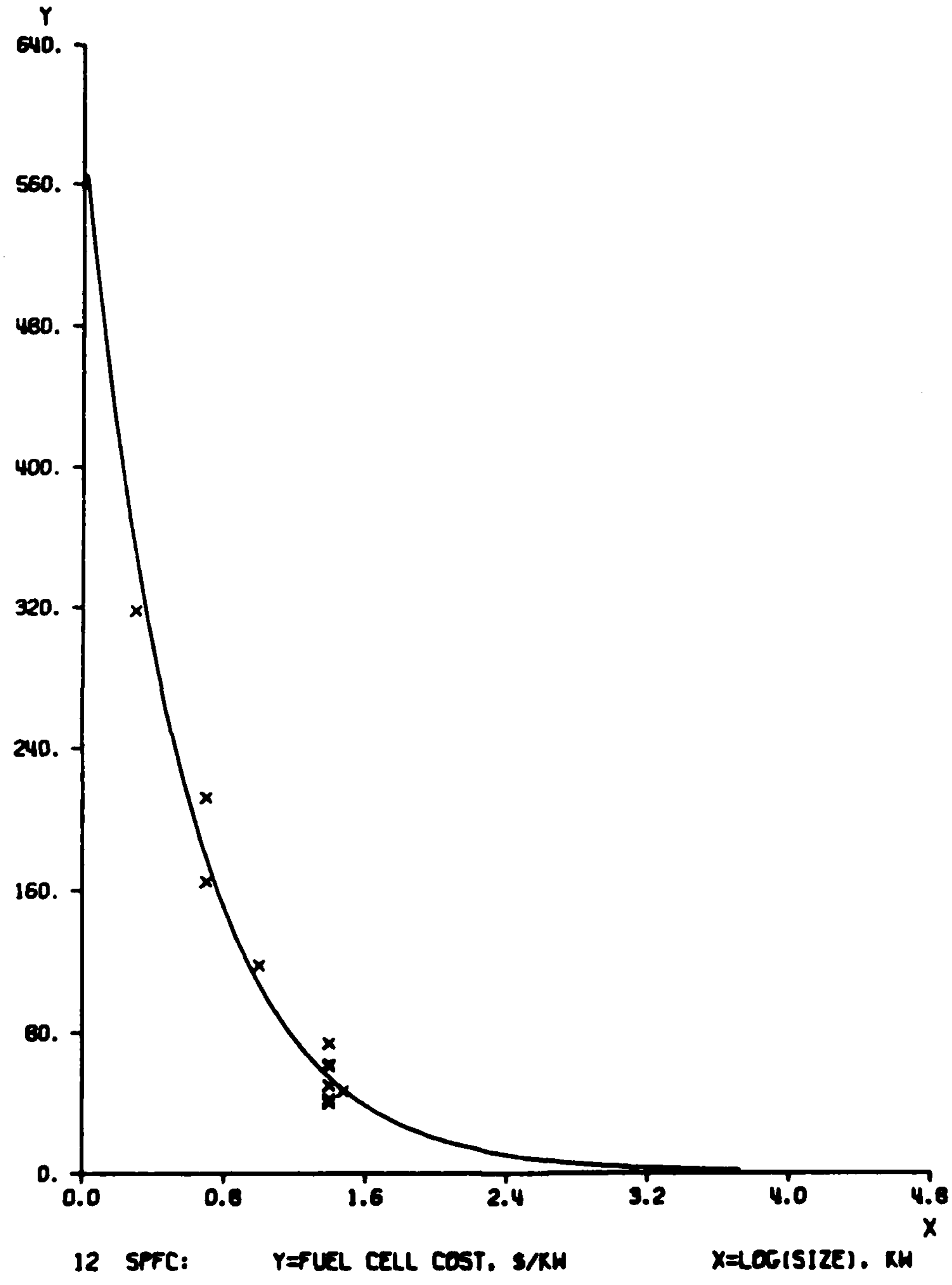

Figure 26. SOLID POLYMER ELECTROLYTE FUEL CELL STACK ACQUISITION COST VERSUS SIZE

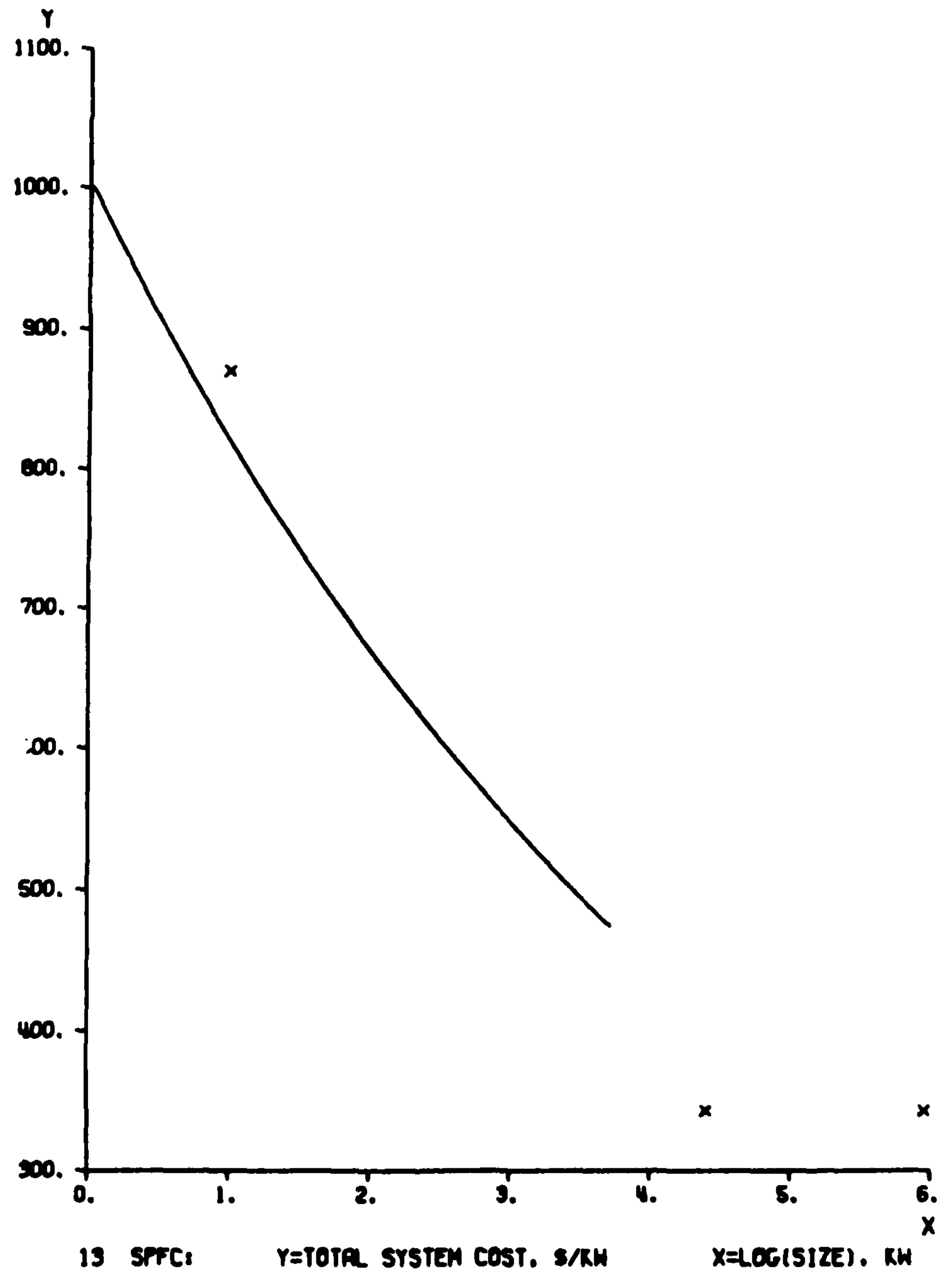

Figure 27. SOLID POLYMER ELECTROLYTE FUEL CELL ENERGY CONVERSION SYSTEM ACQUISITION COST VERSUS SIZE

The solid polymer electrolyte is usually a plastic film a few mills thick fabricated from an ion exchange material called Nafion (produced by the DuPont Co.) which is a sulfonated analog of Teflon. Nafion is not in short supply. The cost of producing Nafion has been dropping rapidly as the demand for it increases, which results in its mass production. Other polymers such as phenol — formaldehyde sulfonic acid are also used for this purpose.

Electrodes for this cell utilize expensive materials: platinum at the cathode and gold at the anode. These metals are in short supply, and widespread use of them drives their prices higher.

Weight

The data available on the weight of SPE fuel cell systems are not adequate for statistical analysis because more than one parameter varies in each case as can be seen from Table 34. However, based on the projected values for the H_2O, HCl, and HBr cycles, a typical value of about 40 lb/kW is expected for the total system. The weight of the cells themselves was reduced from 70 lb/kW in 1962 to 20 lb/kW in 1974.

Table 34. DATA ON WEIGHT OF SOLID POLYMER ELECTROLYTE FUEL CELL ENERGY CONVERSION SYSTEMS

Weight		Plant	Assumptions of
Study	Operating Plant	Size, kW	Advanced State-of-the-Art
	70	1	(1962-68) Gemini and Bio-satelite
	35	1	(1968-1970) Air Force Program
	20	1	(1970-74) Space Shuttle
4-10		1	Projected
	58.2	25	1978 State of H_2O Cycle
	53.4	25	1978 State of HCl Cycle
	59.4	25	1978 State of HBr Cycle
39.4		25	Projected of H_2O Cycle
37.6		25	Projected of HCl Cycle
43.6		25	Projected for HBr Cycle

Volume

Only one data point was identified in the literature search; its value is 0.205 ft^3/kW for a 30-kW system. This includes dead space to hold the water produced.

Start-Up and Shutdown Times

No data are available. However they are expected to be shorter than the corresponding values for the phosphoric acid fuel cell systems because the SPE fuel cell operates at lower temperature.

Operation and Maintenance Cost

No data are available. However it is expected to be slightly less than that for phosphoric acid fuel cell systems because of the lower operating temperature.

Efficiency

Projected efficiency is about 40%.

Mobility

Systems larger than about 1 MW are not mobile. The smaller the system the more mobile it is. Transportation of systems up to about 1 MW may be possible.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 35, 36, 37, and 38, respectively.

Table 35. SOLID POLYMER ELECTROLYTE FUEL CELL ENERGY CONVERSION SYSTEM LOCATION CONSTRAINTS

Constraint	Effect	Remarks
1. Water Requirements	---	Produces water
2. Manning Requirements	---	Fully automated
3. Fuel availability and delivery	●	Especially if liquid or solid fuels are used as the source of fuel
4. Fuel Storage	O	Especially in remote areas where gas pipelines are not available
5. Other	---	

Overall Assessment: The ordinal score is 4 indicating moderate locational constraints.

75(3)/RPE/61045Q

Table 36. SOLID POLYMER ELECTROLYTE FUEL CELL ENERGY CONVERSION SYSTEM OPERATION CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability and Efficiency	0	Efficiency not affected by part-load
2. Overload Capability	◓	Fuel cells have very limited overload capability
3. Load Following Capability	0	

Overall Assessment: The ordinal score is 3 indicating average turn-down capability.

75(3)/RPE/61045Q

Table 37. SOLID POLYMER ELECTROLYTE FUEL CELL ENERGY CONVERSION SYSTEM RELIABILITY

Constraint	Effect	Remarks
1. Moving Parts	--	No effect
2. Operating Temperature	0	less than 210°F (stack), 1000° to 2000°F (fuel processor)
3. Modularity of Design	0	Most components available in many different sizes
4. Stress Levels	0	Minor
5. Corrosion	0	Minor
6. Other	●	Platinum-coated electrodes are poisoned by minute concentrations of CO

Overall Assessment: The ordinal score is 4 indicating moderate reliability.

69(3)/toc/ER

Table 38. SOLID POLYMER ELECTROLYTE FUEL CELL ENERGY CONVERSION SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty in Meeting More Stringent Regulations	Remarks
• Thermal Discharge	0	—	—	low operating temperatures (< 100°C)
• Air Pollution				
CO	—	—	—	
NO_x	—	—	—	
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Other	—	—	—	
• Noise	0	0	•	
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

75(3)/RPR/61045Q

FUEL CELL ENERGY CONVERSION SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Fuel Cells-Molten Carbonate

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 17	50.2			
F. 31	32-46			
F. 16	35-48			
F. 37	46-49.6			
F. 75	45			Program target 1990-1995
F. 69	40-55			
F. 59	45			
F. 7	49.6		635,000	Based on HHV of coal (ECAS Design: F.C. combined with steam turbine)
F. 86	45.5		5,000	Oil Fueled
F. 86	50.2		675,000	Coal Fueled
F. 87	45.0			
F. 88	45.5			Goal
F. 89	54.4		1,255,000	Power plant with bottoming cycle
F. 89	45.7		1,255,000	Overall with bottoming cycle

DATA SHEET

Energy Conversion System: Fuel Cells-Molten Carbonate

Parameter: O&M Cost (10^{-3} \$/KwHr)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 37	3.5			
F. 89	19		1,255,000	

DATA SHEET

Energy Conversion System: Fuel Cells-Molten Carbonate

Parameter: Aquisition Cost ($/KW) (All in 1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 5	2200		10,000	With gasifier
	2205		10,000	With gasifier and steam turbine bottoming cycle
F. 67	835			Based on UTC/IGT work
	1338			Based on UTC/W/GE work
F. 31	522-706			Does not include gasifier
F. 16	843		635,000	Installed and including land and gasifier (based on ECAS design)
F. 16	132			Fuel cell subsystem alone
F. 16	85			Fuel cell stack alone
F. 37	566-637			
F. 75	947-1065			Program target 1990-1995 (installed cost)
F. 59	272			Total cost (F.C. and fuel processor and inverter)
F. 7	843		635,000	Total plant cost of fuel cell and steam turbine. Bottoming cycle. Based on ECAS design
F. 7	85			Stack cost goal
F. 86	947		675,000	Coal fired
F. 87	332			Goal
F. 89	571		1,255,000	

DATA SHEET

Energy Conversion System: Fuel Cells-Molten Carbonate

Parameter: Lifetime* (hrs)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Frequency Of Operation	Assumptions of Advanced State of the Art
F. 21	40,000		Continuous	Projected
F. 21		15,000	Continuous	Achieved-lab schale
F. 67	40,000		Continuous	Projected
F. 75	40,000		Continuous	Program target 1990-1995
F. 69	50,000		Continuous	Estimate: 1985
F. 7	40,000			
F. 7		40,000	Continuous	Lab scale cells fabricated from Alumina
F. 7		15,000	Continuous	Lab scale cells fabricated from stainless steel
F. 86	52,560*			Coal fired-675 MW plant
F. 89	10,000-50,000			

*stack only

DATA SHEET

Energy Conversion System: Fuel Cells-Molten Carbonate

Parameter: Operational Constraints

Constraint	Energy Conversion Systems Reference: Studies	Energy Conversion Systems Reference: Operating Plants
Environmental	F. 37, F. 21, F. 67	
Thermal Discharge		
Air Pollution		
Noise		
Solid Waste		
Chemical Waste		
Location		
Water Requirements		
Manning Requirements		
Fuel Delivery		
Solar Insolation		
Wind Requirement		
Metropolitan Siting		
Electrical Power Requirement		
Operational		
Part Load Efficiency		
Part Load Capability		
Solar, Wind Dependence		
Overload Capacity		
Load Following		
Life Dependence on Cycling		

Environmental Constraints: (Fuel Cells-Molten Carbonates)

The environmental constraints of the power system are indicated in the following tabulation:

X amount of uncontrolled emission

Y amount of pollution which would be emitted with no controls

Z degree of difficulty in meeting more strict regulations

Key: blank - none

0 - minor

◐ - moderate

● - major

Emissions	X	Y	Z	Ref.
Thermal Discharge	0.50			F. 21
(MMBTU/MMBTU Coal)	1.00			F. 67
Air Pollution (lbs. MM BTU coal)				
CO				
HC				
NO_x	<0.03 <0.10			F. 21 F. 37
SO_x	<0.10			F. 21
Particulates	<0.05			F. 21
Noise				
Solid Waste				
Chemical Waste				
Radioactive Waste				

DATA SHEET

Energy Conversion System: Fuel Cells-Molten Carbonate

Parameters:	Energy Conversion System Reference	
	Studies	Operating Plants
Reliability		
Growth Potential		
Availability of Raw Materials	F.61, F.50, F.26, F.72	
Type		
Development		

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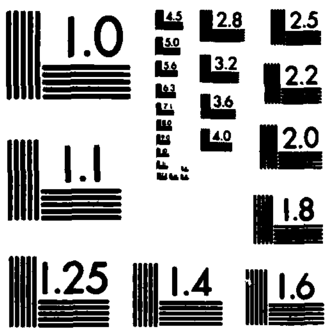

MICROCOPY RESOLUTION TEST CHART
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Operational Constraints: (Fuel Cells - Molten Carbonate)

The tabulated operating characteristics are applicable to the power system as indicated.

— - Characteristic not observed in system operation

0 - Characteristic has minor effect on system performance

θ - Characteristic has moderate effect on system performance

● - Characteristic has major effect on system performance

Operational Restraint	Symbol	Ref.
Efficiency reduction at part load	0	F. 21
Part load capability limitation	0	F. 21
Dependence on solar insolation	NA	
Dependence on wind consistency	NA	
Overload capacity limitations	θ	
Delayed response to rapid load changes	0	
Life reduction from frequent rapid load changes	0	

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: Efficiency

Energy Conversion System Reference	Parameter Value: Study	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 12	41.5- 42.7		60	In the range of 25% - 100% load
F. 20	35.2			High pressure
	36.7			Atmosphere pressure
F. 64	37.9		5	
	40.9		10	
	46.4		25	
F. 31	24-29			
F. 24	40-45			
F. 71	38			
F. 38	37-40			
F. 33	40		40	
F. 37	38-40			
F. 75	37			Program target for 1985
F. 75	45			Program target for 1990-1995
F. 69	38			
F. 69	40			Goal
F. 69		40		40 kW-Natural gas test unit
F. 59	38-40		26,000	Projected for total system
F. 78	45.5			DOE-EPRI-UTC goal
F. 78	46.6		26,000	(heat rate= 7315 Btu/KwHr)
F. 78	31.8		100	Based on HHV of SNG fuel
F. 79	38.3		5,000	Naphtha fuel
	46.8		25,000	#2 fuel oil
	41.1		10,000	#2 fuel oil
	46.8		5,000	#2 fuel oil

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: Efficiency (continued)

Energy Conversion System Reference	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 80	41.6		60	ERC-Data Methanol fuel - 100% load
	42.3		60	Methanol fuel - 75% load
	42.7		60	Methanol fuel - 50% load
	41.5		60	Methanol fuel - 25% load
	41.3		60	ERC-Data Propane Fuel 100% load
	42.5		60	75% load
	42.4		60	50% load
	40.2		60	25% load
	34.5		15	ERC Data-Methanol fuel 25% load
	36.4		15	50% load
	35.6		15	75% load
	35.7		15	100% load
	34.9		15	125% load
	32.2		15	200% load
	35.6		15	ERC-Data Propane Fuel 25% load
	37.7		15	50% load
	37.4		15	75% load
	36.7		15	100% load
	36.7		15	117% load
	35.7		15	150% load
	34.1		15	200% load
F. 8	40.0		40	Interpulated from a curve for load factors 20-100%
F. 87	40.0			
F. 89	29.8		48,000	Power plant efficiency
	1510		48,000	Overall efficiency
	35.5		23,000	Power plant efficiency
	23.9		23,000	Overall efficiency

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: Volume/Size (Ft^3/KW)

Energy Conversion System Reference	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 12	1.47*		15	Methanol fueled
	2.21*		15	Propane fueled
	1.21		15	Excluding fuel storage
	0.73*		60	Methanol fueled
	1.24*		60	Propane fueled
F. 59	(0.58 ft^2)			Footprint size based on the 26 MW planned plant
F. 80	1.2		40	UTC-Data
	0.43		15	ERC-Data

*Including fuel storage for automobile operation.

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: Weight (lbs/KW)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 12	22		60	Pressurized system-methanal fueled
	28		60	Pressurized system-propane fueled
F. 22	80			Hydrocarbon-air fuel cell. General not necessarily PAFC.
F. 80	45.0		40	UTC-Data
	27.6		15	ERC-Data-methanol/air
	27.6		15	ERC-Data-propane/air
F. 43	220		5	1964 technology

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: Start-up/Shut-down Time (minutes)

Energy Conversion System Reference	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 12	10-15			From idle position
F. 64	240			From cold start
F. 4	(5 sec.)		2	After the cell is heated to its operating temperature. Gulf cart application

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: O&M Cost (10^{-3}\$/KwHr in 1980 dollars)

Energy Conversion System Reference	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 20	3.4-5.8		4800	88.1% Capacity factor
	7.4-13.5		4800	30.0% Capacity factor
F. 64	4.40		5-25	
F. 37	3.50			
F. 97	4.03		5000	Naphtha fuel
	4.03		25,000	#2 fuel oil
	4.03		10,000	#2 fuel oil
	4.03		5,000	#2 fuel oil
F. 80	1.99		25	85% Capacity factor
	1.27		40	85% Capacity factor
	0.54		100	85% Capacity factor
	0.18		250	85% Capacity factor
F. 80	1.08 - 1.63		40	UTC-Data w/o replacement
	8.21		40	UTC-Data with replacement
F. 89	6.5		48,000	
	11.7		23,000	

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: Aquisition Cost ($/KW) (in 1980 dollars)

Energy Conversion System Reference	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 12	89		60	Cost of stack only for methanol fueled system
	90		60	Cost of stack only for propane fueled system
F. 20	380-816		4800	N.G. and Naphtha fueled
F. 5	580		10,000	Using distillate fuels
F. 64	359		5	
	359		10	
	283		25	
F. 31	380-490			
F. 71	404			Break-even capital cost for intermediate applications
	538-673			Break-even capital cost for peak applications
F. 35	604		40	Installed cost
	456		40	Not installed
	1240		40	1978 estimate by UTC of the cost of the 50th manufactured unit
F. 33	509		250	Installed cost
	129		250	Stack replacement
F. 37	601-672			Coal fueled
F. 75	414-474			Program goals (installed cost)
F. 69	295			Goal
F. 59	287			Projected for total plant (FC and Fuel processor and converter)
F. 79	354		5,000	Naphtha fuel
	283		25,000	#2 fuel oil
	354		10,000	#2 fuel oil
	283		5,000	#2 fuel oil
F. 80	634		25	Installed cost
	573		40	Installed cost
	525		100	Installed cost
	509		250	Installed cost
	132		25	Stack replacement
	129		40	Stack replacement
	129		100	Stack replacement
	129	289	250	Stack replacement

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: Aquisition Cost ($/kW) (In 1980 dollars) (continued)

Energy Conversion System Reference	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 80	156		15	ERC-Data for stack only
F. 80	156		15	ERC-Data for stack only
F. 89	673		48,00	Total capitalization
	438		23,00	Total capitalization
	528		25,00	Total capitalization
	508		100,00	Total capitalization
	500		250,00	Total capitalization

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter: Lifetime (Hrs)

Energy Conversion System Reference	Parameter Value Study	Parameter Value Operating Plant	Frequency Of Operation	Assumptions of Advanced State of the Art
F. 12	43,800		Continuous	60 KW plant
F. 20	154,350		88.1%	4.8 MW plant with replacement
F. 29	175,200		Continuous	
F. 38	20,000			
F. 33	43,800		One outage per year	
F. 75	40,000			Program target
F. 28	>26,300		Continuous	Stack only
F. 69	40,000			Goal
F. 41		15000		Estimated for 12 watts and 750 watt units built by Englehard operating on hydrogen and air
F. 59	87,600			Projected for the 26 MW planned station
F. 78	40,000			Stack life
F. 80	40,000			Stack life (time between major overhausl UTC-Data)
F. 89	10,000 40,000		23,000 48,000	

DATA SHEET

Energy Conversion System: Fuel Cells-Phosphoric Acid

Parameter:

Constraint	Energy Conversion Systems Reference: Studies	Energy Conversion Systems Reference: Operating Plants
Environmental	F. 37, F. 12, F. 78	
Thermal Discharge		
Air Pollution		
Noise		
Solid Waste		
Chemical Waste		
Location		
Water Requirements		
Manning Requirements		
Fuel Delivery		
Solar Insolation		
Wind Requirement		
Metropolitan Siting		
Electrical Power Requirement		
Operational		
Part Load Efficiency		
Part Load Capability		
Solar, Wind Dependence		
Overload Capacity		
Load Following		
Life Dependence on Cycling		

DATA SHEET

Energy Conversion System: Fuel Cells- Phosphoric Acid

Parameters:	Energy Conversion System Reference: Studies	Operating Plants
Reliability	F. 8 one unscheduled shutdown per year	
Growth Potential		
Availability of Raw Materials		
Type		
Development		

DATA SHEET

Energy Conversion System: Fuel Cells-Solid Polymer (SPE)

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 2	40			Based on LHV of fuel
F. 87	>45			
F. 89	51.1		102,000	Power plant efficiency
	31.1		102,000	Overall efficiency

DATA SHEET

Energy Conversion System: Fuel Cells-Polymer (SPE)

Parameter: Volume/Size (ft^3/KW)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 28	0.205			(46 gallons/30 KW with dead space to hold the the water produced)

DATA SHEET

Energy Conversion System: Fuel Cells-Polymer (SPE)

Parameter: O&M Cost

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 89	4.9		102,000	

DATA SHEET

Energy Conversion System: Fuel Cells-Solid Polymer (SPE)

Parameter: Weight (lb/KW)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 9		70	1	(1962-68) Gemini and Bio-satilite
		35	1	(1968-1970) Air Force program
		20	1	(1970-74) Space Shuttle
		4-10	1	Projected (LRC/JSC) after 73.
		58.2	25	1978 State for H_2O cycle
		53.4	25	1978 State for HCL cycle
		59.8	25	1978 State for HBr cycle
		39.4	25	Projected for H_2O cycle
		37.6	25	Projected for HCL cycle
		43.6	25	Projected for HCL cycle

DATA SHEET

Energy Conversion System: Fuel Cells-Solid Polymer (SPE)

Parameter: Lifetime*

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Frequency Of Operation	Assumptions of Advanced State of the Art
F. 9		6000	Continuous	0.7 Ft^2 cells at intermediate current density and temp. and low pressure
		4000	Continuous	At high pressure and high current density
		5000	Continuous	1 KW modules
		6500	Continuous	3 cell assembly
		8000	Continuous	Demonstration-1968
		20,000	Continuous	Demonstration-1972
		51,000	Continuous	Demonstration-1975
F. 31		40,000 10,000		
F. 63		34,000		Using Nafion (R)
F. 38		35,000		
F. 2		48,000		At 43-82^{o}C
F. 89		100,000		

* stack only

DATA SHEET

Energy Conversion System: Fuel Cells-Solid Polymer (SPE)

Parameter: Aquisition Cost ($/KW) (In 1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
F. 19	165-318		2-5	Projection-include reformer
F. 9		25,4000	1	Space Shuttle-1970-74
		63,500	1	A.F. Program 1969-1970
		158,800	1	Gemini and Biosatalite Program 1962-1968
		(1,270-19,000)	1	Projected for after 1973
		74	25	Cost of H_2O cycle
		61	25	Cost of HCL cycle
		62	25	Cost of HCL cycle
		50	25	Cost of HBR cycle
		40	25	Projected for H_2O cycle
		42	25	Projected for HCL cycle
F. 29	368		25	Projected for HBR cycle
	227			
			5	
F. 30	533-1207		10	
F. 2	343		25000-900,000	Total including indirect cost
	212			
	118		5	
			10	
F. 28	47			Future projection
			30	After the first 2 cells are produced
F. 89	286		102,000	

FUEL CELL ENERGY CONVERSION SYSTEMS

Bibliography

F-1

ACCESSION NO.	80N0077527
TITLE(MONO)	FUEL CELL RESEARCH ON SECOND-GENERATION MOLTEN-CARBONATE SYSTEMS
CORPORATE AUTH	INSTITUTE OF GAS TECHNOLOGY, CHICAGO, IL (USA)
PAGE NO	116
AVAILABILITY	NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT AC03-78ET11276
DATE	DEC 1979
CATEGORIES	EDB-300501;300503;360201;360203
PRIMARY CAT	EDB-300501
REPORT NO	SAN--11276-2
ABSTRACT	THE PROGRAM EMPHASIS FOCUSES ON IDENTIFYING SOLUTIONS TO TILE FAILURE CAUSED BY THERMAL CYCLING, DEVELOPING COST-EFFECTIVE CELL COMPONENTS (PRIMARILY THE BIPOLAR CELL SEPARATOR PLATE), AND DETERMINING THE PERFORMANCE AND ENDURANCE CHARACTERISTICS OF BASELINE AND NEWLY DEVELOPED CELL COMPONENTS. STRUCTURAL ANALYSIS OF THE CELL PACKAGE SHOWED THAT ELECTROLYTE TILE CRACKING CAUSED BY THERMAL CYCLING CAN BE GREATLY REDUCED BY REDUCING THE THERMAL EXPANSION DIFFERENCE BETWEEN THE CELL SEPARATOR PLATE AND THE ELECTOLYTE TILE AND BY REDUCING THE RATIO OF THE SEPARATOR PLATE THICKNESS TO THE ELECTROLYTE TILE THICKNESS. THE FEASIBILITY OF THIS ANALYTICAL MODELING APPROACH WAS DEMONSTRATED BY THE GOOD AGREEMENT BETWEN EXPERIMENTALLY DETERMINED CRACKING BEHAVIOR AND THAT PREDICTED BY THE STRUCTURAL MODELS DEVELOPED. FURTHER VERIFICATION IS PLANNED FOR THE NEXT QUARTER. MECHANICAL PROPERTY MEASUREMENTS CONTINUED TO BE MADE ON A VARIETY OF ELECTROLYTE TILE COMPOSITIONS. THE TILE MICROSTRUCTURE (AGGLOMERATE SIZE AND LIALO SUB 2S DISTRIBUTION) CONTINUED TO STRONGLY AFFECT THE TILE STRENGTH. CARBONATE COMPOSITION WERE IDENTIFIED THAT MATCHED MORE CLOSELY THE THERMAL EXPANSION OF THE METALLIC CELL COMPONENTS. CELL TESTING OF THESE COMPOSITIONS IS SHOWING GOOD PERFORMANCE. A POTENTIALLY COST-EFFECTIVE METHOD OF FABRICATING ELECTROLYTE TILES AND ELECTRODES USING THE TAPE-CASTING METHOD WAS DEMONSTRATED. IN ADDITION, GOOD POWDER QUALITY WAS ACHIEVED USING THE SPRAY-DRYING TECHNIQUE FOR ELECTROLYTE POWDER PREPARATION. ALTHOUGH FURTHER DEVELOPMENT IS REQUIRED TO OBTAIN ACCEPTABLE CELL COMPONENTS, INITIAL RESULTS APPEAR QUITE PROMISING. BENCH-SCALE CELLS (94-CM SUP 2) USING 10-MIL SHEET METAL CORRUGATED BIPOLAR PLATES WERE DEVELOPED AND SUCCESSFULLY OPERATED.
DESCRIPTORS	ALUMINATES: T3;ANALYTICAL SOLUTION;BATTERY SEPARATORS;CATHODES;CRYSTAL DOPING;DATA;DESIGN: U1;EUTECTICS;FABRICATION: U2,U3;FAILURES: U2,U3;FRACTURES;GRAPHS;LITHIUM COMPOUNDS: T2;MATERIALS;MATHEMATICAL MODELS;MATRIX MATERIALS: T4,Q1;MECHANICAL PROPERTIES: U4;MICROSTRUCTURE;MOLTEN CARBONATE FUEL CELLS: T1;NICKEL OXIDES;PERFORMANCE;PERFORMANCE TESTING;SERVICE LIFE;SINTERED MATERIALS;STRESSES;THERMAL CYCLING;THERMAL EXPANSION;THICKNESS

F-2

ACCESSION NO.	80C0066369
TITLE	ASSESSMENT OF THE SOLID POLYMER ELECTROLYTE FUEL CELL FOR MOBILE POWER PLANTS
AUTHORS	MCELROY, J.F.
AUTHOR AFF	GENERAL ELECTRIC CO., WILMINGTON, MA
TITLE(MONO)	TWENTY-EIGHTH POWER SOURCES SYMPOSIUM
SEC REPT NO	CONF-780624--
PAGE NO	32-34
CONF TITLE	POWER SOURCES SYMPOSIUM
CONF PLACE	ATLANTIC CITY, NJ, USA
CONF DATE	12 JUN 1978
PUBL LOC	ELECTROCHEMICAL SOCIETY, INCORPORATED, PRINCETON, NJ
DATE	1978
CATEGORIES	EDB-300502;300501
PRIMARY CAT	EDB-300502
ABSTRACT	DURING THE COURSE OF RECENT INVESTIGATIONS TO INCREASE THE CURRENT DENSITY CAPABILITIES OF THE HYDROGEN/OXYGEN CONFIGURATION, A SERIES OF CATHODE AIR ACTIVATION TECHNIQUES WERE PERFORMED. ALTHOUGH THE HYDROGEN/AIR OPERATION WAS PERFORMED PURELY FOR ACTIVATION PURPOSES, SIGNIFICANT HIGH CURRENT DENSITY DATA WERE OBTAINED. PROJECTIONS MADE FROM THIS DATA INDICATE THAT HYDROGEN/AIR PERFORMANCE AT 1.0 A/CM SUP 2 AND 0.60 VOLT DC IS A DISTINCT POSSIBILITY. (WHK)
DESCRIPTORS	AIR;CARBON DIOXIDE;CATHODES;COST;CURRENT DENSITY;HYDROGEN FUEL

CELLS: T1;PERFORMANCE: U1;POLYMERS;SERVICE LIFE;SOLID ELECTROLYTES: U1;WATER REMOVAL

F-3

ACCESSION NO.	80U0065435
REPORT NO.PAGE	EPRI-P--1309-SR PP. 201-246
TITLE	ENERGY MANAGEMENT AND UTILIZATION DIVISION
TITLE(MONO)	1980-1984 RESEARCH AND DEVELOPMENT PROGRAM PLAN: PROGRAM DESCRIPTIONS
PAGE NO	201-246
AVAILABILITY	DEP. NTIS, PC A23/MF A01.
DATE	FEB 1980
CATEGORIES	EDB-200100;296001;291000;250000;290700
PRIMARY CAT	EDB-200100
REPORT NO	EPRI-P--1309-SR
ABSTRACT	THE PRIMARY ACTIVITIES OF THE DIVISION FALL IN THE EPRI RESEARCH AREAS, ENERGY CONVERSION AND ENERGY STORAGE AND MANAGEMENT, IDENTIFIED IN THE OVERVIEW AND STRATEGY DOCUMENT (EPRI-PS--1141-SR). AMONG THE R AND D GOALS ESTABLISHED FOR THESE AREAS, THE ONES MOST PERTINENT TO THE DIVISION'S ACTIVITIES ARE TO: (1) DEVELOP ADVANCED, COST-EFFECTIVE SYSTEMS FOR GENERATION OF ELECTRICITY; (2) PROVIDE SYSTEMS AND EQUIPMENT THAT WILL PERMIT ECONOMICAL ENERGY STORAGE AND WORKABLE CONCEPTS FOR MANAGEMENT OF ELECTRIC LOADS; AND (3) DEVELOP TECHNICAL ADVANCES TO ACHIEVE CONSERVATION OF ENERGY AND OTHER RESOURCES THROUGH EFFICIENT USE OF ELECTRICITY. THE FOLLOWING PROGRAMS ARE DESCRIBED IN DETAIL: ENERGY STORAGE; FUEL CELLS AND CHEMICAL ENERGY CONVERSION; AND ENERGY UTILIZATION AND CONSERVATION.
DESCRIPTORS	ELECTRIC POWER: T3;ENERGY CONVERSION: T1;ENERGY EFFICIENCY: T,U3; ENERGY STORAGE: T,U1,U2;EPRI: T1;FUEL CELLS: T;LOAD MANAGEMENT: T2;POWER GENERATION: T1;RESEARCH PROGRAMS: U1,U2,U3

F-4

ACCESSION NO.	80U0001372
TITLE(MONO)	FUEL-CELL-POWERED GOLF CART
EDITOR OR COMP	HUDGELL, R.E.; MCCORMICK, J.B.; LYNN, D.K.; KERWIN, W.J.; DERUVIN, C.R.; SALAZAR, P.M.
CORPORATE AUTH	LOS ALAMOS SCIENTIFIC LAB., NM (USA)
SEC REPT NO	CONF-800523--1
PAGE NO	25
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-36
CONF TITLE	3. INTERNATIONAL ELECTRIC VEHICLE EXPOSITION AND CONFERENCE
CONF PLACE	ST. LOUIS, MO, USA
CONF DATE	MAY 1980
DATE	1980
CATEGORIES	EDB-300504;330401
PRIMARY CAT	EDB-300504
REPORT NO	LA-UR--80-616
ABSTRACT	THE IMPLEMENTATION OF A BATTERY/FUEL-CELL-POWERED GOLF CART TEST BED DESIGNED TO VERIFY COMPUTER SIMULATIONS AND TO GAIN OPERATIONAL EXPERIENCE WITH A FUEL CELL IN A VEHICULAR ENVIRONMENT IS DESCRIBED. A TECHNICALLY UNTRAINED DRIVER CAN EASILY OPERATE THE GOLF CART BECAUSE THE MOTOR AND FUEL CELL CONTROLLERS AUTOMATICALLY SENSE AND EXECUTE THE APPROPRIATE ON/OFF SEQUENCING. A VOLTAGE IMBALANCE CIRCUIT AND A THROTTLE COMPRESS CIRCUIT WERE DEVELOPED THAT ARE DIRECTLY APPLICABLE TO ELECTRIC VEHICLES IN GENERAL.
DESCRIPTORS	ACID ELECTROLYTE FUEL CELLS: T2,U1;ALCOHOL FUEL CELLS;DESIGN: U2;ELECTRIC BATTERIES;HYBRID ELECTRIC-POWERED VEHICLES: T1; HYDROGEN FUEL CELLS;HYDROGEN GENERATORS;METHANOL;OPERATION; PHOSPHORIC ACID;POWER RANGE 1-10 KW;SHUTDOWNS;START-UP

F-5

ACCESSION NO.	80U0001082
TITLE(MONO)	COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS): GENERAL ELECTRIC COMPANY FINAL REPORT. VOLUME I. SUMMARY REPORT
EDITOR OR COMP	GERLAUGH, H.E.; HALL, E.W.; BROWN, D.H.; PRIESTLEY, R.R.; KNIGHTLY, W.F.
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). CORPORATE RESEARCH AND DEVELOPMENT DEPT.
SEC REPT NO	NASA-CR--159765(VOL.1)
PAGE NO	155

AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT EC-77-A-31-162
DATE	JAN 1980
CATEGORIES	EDB-200100;320204;290600
PRIMARY CAT	EDB-200100
REPORT NO	DOE/NASA/0031--80/1
ABSTRACT	LARGE SAVINGS CAN BE MADE IN INDUSTRY BY COGENERATING ELECTRIC POWER AND PROCESS HEAT IN SINGLE ENERGY CONVERSION SYSTEMS RATHER THAN SEPARATELY IN UTILITY PLANTS AND IN PROCESS BOILERS. THIS STUDY EXAMINES THE USE OF VARIOUS ADVANCED ENERGY CONVERSION SYSTEMS AND COMPARES THEM WITH EACH OTHER AND WITH CURRENT TECHNOLOGY SYSTEMS FOR THEIR SAVINGS IN FUEL ENERGY, COSTS, AND EMISSIONS IN INDIVIDUAL PLANTS AND ON A NATIONAL LEVEL. ABOUT FIFTY INDUSTRIAL PROCESSES FROM THE LARGEST ENERGY CONSUMING SECTORS WERE USED AS A BASIS FOR MATCHING A SIMILAR NUMBER OF ENERGY CONVERSION SYSTEMS THAT ARE CONSIDERED AS CANDIDATE WHICH CAN BE MADE AVAILABLE BY THE 1985 TO 2000 TIME PERIOD. THE SECTORS CONSIDERED INCLUDED FOOD, TEXTILES, LUMBER, PAPER, CHEMICALS, PETROLEUM, GLASS, AND PRIMARY METALS. THE ENERGY CONVERSION SYSTEMS INCLUDED STEAM AND GAS TURBINES, DIESELS, THERMIONICS, STIRLING, CLOSED-CYCLE AND STEAM INJECTED GAS TURBINES, AND FUEL CELLS. FUELS CONSIDERED WERE COAL, BOTH COAL AND PETROLEUM-BASED RESIDUAL AND DISTILLATE LIQUID FUELS, AND LOW BTU GAS OBTAINED THROUGH THE ON-SITE GASIFICATION OF COAL. AN ATTEMPT WAS MADE TO USE CONSISTENT ASSUMPTIONS AND A CONSISTENT SET OF GROUNDRULES SPECIFIED BY NASA FOR DETERMINING PERFORMANCE AND COST. ATMOSPHERIC AND PRESSURIZED FLUIDIZED BED STEAM TURBINE SYSTEMS ARE THE MOST ATTRACTIVE OF THE DIRECT COAL-FIRED SYSTEMS. OPEN-CYCLE GAS TURBINES WITH HEAT RECOVERY STEAM GENERATORS AND COMBINED-CYCLES WITH NO/SUB X/ EMISSION REDUCTION AND MODERATELY INCREASED FIRING TEMPERATURES ARE THE MOST ATTRACTIVE OF THE COAL-DERIVED LIQUID-FIRED SYSTEMS.
DESCRIPTORS	CO-GENERATION: T5,U1,D;COAL;COMPARATIVE EVALUATIONS;DIESEL ENGINES;ECONOMIC ANALYSIS: D;ELECTRIC POWER;ENERGY CONSERVATION: G1,U5,D;ENERGY CONVERSION;ENVIRONMENTAL EFFECTS: U5;FLUIDIZED-BED COMBUSTION;FUEL CELLS;GAS TURBINES;GRAPHS: U;INDUSTRIAL PLANTS: T1,D;NUMERICAL DATA: D;PROCESS HEAT;REVIEWS;STEAM TURBINES;STIRLING ENGINES;TABLES: D;TECHNOLOGY ASSESSMENT: U5;USA

F-6

ACCESSION NO.	80N0001040
TITLE(MONO)	ANALYSIS OF REMOTE SITE ENERGY STORAGE AND GENERATION SYSTEMS. FINAL TECHNICAL REPORT JULY 1978-JUNE 1979
EDITOR OR COMP	CRISP, J.N.; BISHOP, W.S.; PINSON, J.D.; ANDERSON, L.A.
CORPORATE AUTH	DAYTON UNIV., OH (USA). SCHOOL OF ENGINEERING
PAGE NO	148
AVAILABILITY	NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT F33615-77-C-2004
DATE	JUL 1979
CATEGORIES	EDB-200100;290600
PRIMARY CAT	EDB-200100
REPORT NO	AD-A--074009/9
ABSTRACT	THIS REPORT PRESENTS THE RESULTS OF AN INVESTIGATION AND ANALYSIS OF ENERGY STORAGE SYSTEMS AND ALTERNATE ENERGY SOURCES FOR REMOTE SITE APPLICATIONS. THE FIRST PHASE OF THE EFFORT CENTERED ON THE BROAD BASED STUDY OF HYDROGEN STORAGE, THERMAL STORAGE, BATTERIES, AND FLYWHEELS AS ENERGY STORAGE SYSTEMS ALONG WITH WIND TURBINE, SOLAR PHOTOVOLTAIC, AND SOLAR THERMIONIC ENERGY CONVERTERS. A WIND TURBINE BATTERY SYSTEM WAS RECOMMENDED BASED ON PERFORMANCE, COST AND AVAILABILITY. EFFORT UNDER THE SECOND PHASE OF THE PROGRAM CONCENTRATED ON A SYSTEM USING TWO SEPARATE NOMINAL EIGHT KILOWATT WIND TURBINE MODULES IN CONJUNCTION WITH A LEAD-ACID BATTERY ENERGY STORAGE UNIT. THE SYSTEM WAS SPECIFIED TO OPERATE IN CONJUNCTION WITH AN EXISTING POWER GRID SYSTEM LOCATED AT BAR MAIN, BARTER ISLAND, ALASKA. SPECIFIC SYSTEM CONCEPTS AND RECOMMENDATIONS ARE PRESENTED WITH SUPPORTING ANALYSES. A DESIGN CHECKLIST IS INCLUDED WITH SPECIFIC ITEMS FOR CONSIDERATION IN THE PREPARATION OF A DESIGN SPECIFICATION.
DESCRIPTORS	COST;DESIGN;ELECTRIC BATTERIES;ELECTRIC POWER;ENERGY STORAGE: U1;FEASIBILITY STUDIES: U2;FUEL CELLS;PHOTOVOLTAIC EFFECT;POWER GENERATION: U1;POWER PLANTS: T2;REMOTE AREAS: T1;SOLAR ENERGY;THERMAL POWER PLANTS;THERMIONIC CONVERTERS;TURBOGENERATORS;WIN:

ACCESSION NO.	80C0055145
REPORT NO.PAGE	SERI/TP--351-431 PP. 383-388
TITLE	RESULTS OF SYSTEMS SIMULATION AND ECONOMIC ANALYSIS OF A SOLAR-POWERED TURBOCOMPRESSOR HEAT PUMP
AUTHORS	MELIKIAN, G.; RHODES, B.W.; OBEE, T.N.
AUTHOR AFF	UNITED TECH. RESEARCH CENTER, EAST HARTFORD, CT
TITLE(MONO)	SYSTEMS SIMULATION AND ECONOMIC ANALYSIS
SEC REPT NO	CONF-800101--
PAGE NO	383-388
AVAILABILITY	DEP. NTIS, PC A22/MF A01.
CONF TITLE	SYSTEMS SIMULATION AND ECONOMICS ANALYSIS CONFERENCE
CONF PLACE	SAN DIEGO, CA, USA
CONF DATE	23 JAN 1980
DATE	1980
CATEGORIES	EDB-140901
PRIMARY CAT	EDB-140901
REPORT NO	SERI/TP--351-431
ABSTRACT	SINCE 1974, UNITED TECHNOLOGIES HAS BEEN ACTIVELY ENGAGED IN THE DESIGN, DEVELOPMENT AND DEMONSTRATION OF SOLAR-POWERED RANKINE CYCLE HEATING AND COOLIG SYSTEMS FOR BUILDING APPLICATIONS. UNDER A RECENT DOE CONTRACT, UTC HAS BUILT AND TESTED AN 18-TON COOLING CAPACITY, 500,000 BTU/HR HEAT PUMP OVER A WIDE RANGE OF OPERATING CONDITIONS SIMULATING AN ACTUAL BUILDING INSTALLATION. TO ASSIST IN THE HEAT PUMP DESIGN AND ANALYSIS, UTRC HAS DEVELOPED AND USED SEVERAL COMPREHENSIVE SYSTEM SIMULATION AND ECONOMIC ANALYSIS PROGRAMS. COLLECTOR ARRAY SIZE, STORAGE TANK VOLUME AND CONTROL STRATEGIES WERE EVALUATED WITH THESE PROCEDURES. TYPICAL RESULTS OF THE SYSTEM SIMULATIONS FOR BUILDINGS IN SIX SELECTED GEOGRAPHICAL REGIONS ARE DESCRIBED AND THE ECONOMIC POTENTIAL FOR SUCH A SYSTEM IS ILLUSTRATED. THE IMPACT OF VARIATIONS IN PROJECTED FUEL PRICE AND COMPONENT COST LEVEL ON THE UTC SYSTEM ECONOMIC POTENTIAL (I.E., RETURN-ON-INVESTMENT, PAYBACK PERIOD, ETC) IS SHOWN IN DETAIL.
DESCRIPTORS	COMPUTERIZED SIMULATION;COST;DESIGN;ECONOMIC ANALYSIS: Q1,Q2; HEAT PUMPS: T3;PERFORMANCE;RANKINE CYCLE ENGINES;SIZE;SOLAR COLLECTORS;SOLAR COOLING SYSTEMS: T2;SOLAR HEAT ENGINES: T,Q3; SOLAR HEATING SYSTEMS: T1;SYSTEMS ANALYSIS: Q1,Q2; TURBOMACHINERY

F-7

ACCESSION NO.	80J0049629
TITLE	FROM COAL TO ELECTRICAL POWER VIA MOLTEN CARBONATE FUEL CELL
PUB DESC	GAS SCOPE, NO. 43, PP. 2-6
DATE	SUM 1978
CATEGORIES	EDB-300500;010404
PRIMARY CAT	EDB-300500
ABSTRACT	AS A RESULT OF A STUDY ON ENERGY CONVERSION ALTERNATIVES, A NOVEL DESIGN FOR A POWER PLANT HAS BEEN DEVELOPED. A COAL GASIFIER AND PURIFIER PRODUCE PURIFIED GAS WHICH IS FED TO MOLTEN CARBONATE FUEL CELLS. DIRECT CURRENT POWER FROM THE FUEL CELLS IS CONVERTED TO ALTERNATING CURRENT IN SOLID STATE INVERTERS. A DESCRIPTION OF A MOLTEN CARBONATE FUEL CELL IS GIVEN, TOGETHER WITH SOME OF THE ADVANTAGES WHICH THEY HAVE OVER FIRST GENERATION FUEL CELLS. FURTHER TOPICS DISCUSSED ARE THE COAL GASIFICATION PROCESS AND THE COST OF THE ELECTRICAL OUTPUT.
DESCRIPTORS	CARBONATES;COAL GASIFICATION: T2;COST: Q2;FEASIBILITY STUDIES: Q1;FUEL CELL POWER PLANTS: T1;FUEL GAS;HIGH-TEMPERATURE FUEL CELLS;MOLTEN SALTS;POWER GENERATION;PURIFICATION

F-8

ACCESSION NO.	80R0044950
TITLE(MONO)	VENTURE ANALYSIS CASE STUDY FOR ON-SITE FUEL CELL ENERGY SYSTEMS. VOLUME II. APPENDICES A THROUGH I. FINAL REPORT
CORPORATE AUTH	UNITED TECHNOLOGIES CORP., SOUTH WINDSOR, CT (USA). POWER SYSTEMS DIV.
PAGE NO	128
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EX-77-C-01-2684
DATE	31 JUL 1978
CATEGORIES	EDB-300501;290003
PRIMARY CAT	EDB-300501
REPORT NO	FCR--0783(VOL.2)

ABSTRACT THIS VOLUME OF THE REPORT CONTAINS THE FOLLOWING APPENDICES: (A) FUEL CELL POWER PLANT CHARACTERISTICS; (B) MARKET MODEL AND SELECTED OUTPUT; (C) BUILDING CHARACTERISTICS; (D) DATA PROJECTIONS; (E) MANUFACTURER VENTURE DATA; (F) GAS UTILITIES VENTURE DATA; (G) DESCRIPTION OF PARAMETER METHOD; (H) DECISION TREE ANALYSIS FOR PIONEER MANUFACTURER; AND (I) EVALUATION OF GOVERNMENT INCENTIVES. (WHK)

DESCRIPTORS APARTMENT BUILDINGS: T3;COMMERCIAL BUILDINGS: T2; COMMERCIALIZATION;COST;DATA;DECISION TREE ANALYSIS;ECONOMIC ANALYSIS: Q1;FEASIBILITY STUDIES: Q1;FINANCIAL INCENTIVES;FUEL CELL POWER PLANTS: T1,02,03;GAS UTILITIES;MANUFACTURING; MARKETING RESEARCH: Q1;NATIONAL GOVERNMENT;NATURAL GAS FUEL CELLS;POWER RANGE 10-100 KW

F-9

ACCESSION NO. 80R0040453
TITLE(MONO) SOLID POLYMER ELECTROLYTE (SPE) FUEL CELL TECHNOLOGY PROGRAM. FINAL REPORT
CORPORATE AUTH GENERAL ELECTRIC CO., WILMINGTON, MA (USA). AIRCRAFT EQUIPMENT DIV.
PAGE NO 73
AVAILABILITY NTIS, PC A04/MF A01.
CONTRACT NO CONTRACT NAS9-15286
DATE 22 MAR 1979
CATEGORIES EDB-300503
PRIMARY CAT EDB-300503
REPORT NO N--79-21622
ABSTRACT THE OVERALL OBJECTIVES OF THE PHASE IV SOLID POLYMER ELECTROLYTE FUEL CELL TECHNOLOGY PROGRAM WERE TO: (1) ESTABLISH FUEL CELL LIFE AND PERFORMANCE AT TEMPERATURES, PRESSURES AND CURRENT DENSITIES SIGNIFICANTLY HIGHER THAN THOSE PREVIOUSLY DEMONSTRATED; (2) PROVIDE THE GROUND WORK FOR A SPACE ENERGY STORAGE SYSTEM BASED ON THE SOLID POLYMER ELECTROLYTE TECHNOLOGY (I.E., REGENERATIVE H$SUP 2$/O$SUP 2$ FUEL CELL); (3) DESIGN, FABRICATE AND TEST EVALUATE A FULL-SCALE SINGLE CELL UNIT. DURING THIS PHASE, SIGNIFICANT PROGRESS WAS MADE TOWARD THE ACCOMPLISHMENT OF THESE OBJECTIVES.
DESCRIPTORS DESIGN;ENERGY STORAGE SYSTEMS;FABRICATION;HYDROGEN FUEL CELLS: T2;PERFORMANCE TESTING;POLYMERS;REGENERATIVE FUEL CELLS: T1; SERVICE LIFE;SOLID ELECTROLYTES: Q1,Q2

99/5/0000014-0000038// 18

ACCESSION NO. 80C0033510
REPORT NO.PAGE CONF-791229 PP. 209-214
TITLE DEVELOPMENT OF 2 KW SOLAR POWERED STEAM ENGINE SYSTEM
AUTHORS DESHPANDE, A.M.; GUPTA, R.K.; BARVE, K.M.; JAIN, B.C.
AUTHOR AFF JYOTI LTD., BARODA, INDIA
TITLE(MONO) NATIONAL SOLAR ENERGY CONVENTION 1979 OF SOLAR ENERGY SOCIETY OF INDIA
PAGE NO 209-214
AVAILABILITY DEP. NTIS (US SALES ONLY), PC A24/MF A01.
CONF TITLE NATIONAL SOLAR ENERGY CONVENTION
CONF PLACE BOMBAY, INDIA
CONF DATE 13 DEC 1979
DATE 1979
CATEGORIES EDB-140703
PRIMARY CAT EDB-140703
REPORT NO CONF-791229--
ABSTRACT A POTENTIALLY ATTRACTIVE USE OF SOLAR ENERGY IS IN THE FORM OF POWER GENERATION FOR DECENTRALIZED APPLICATIONS. A PROJECT ON DEVELOPMENT OF 2 KW STEAM ENGINE SYSTEM USING CYLINDRICAL PARABOLIC CONCENTRATONS WAS UNDERTAKEN TO EVALUATE THE SYSTEM BOTH FROM TECHNOLOGICAL AS WELL AS ECONOMIC POINTS OF VIEW. A DIESEL ENGINE IS CONVERTED INTO A UNIFLOW TYPE, SINGLE ACTING STEAM ENGINE. A MINIMUM SPECIFIC STEAM CONSUMPTION OF 18 KG/KW-H WAS RECORDED DURING THE TESTS ON THE STEAM ENGINE. NEXT GENERATION OF THE STEAM ENGINE, INCORPORATING FURTHER MODIFICATIONS, IS EXPECTED TO OPERATE AT 12 KG/KW-H SPECIFIC STEAM CONSUMPTION JUST ABOUT THE LOWEST SPECIFIC STEAM CONSUMPTION FOR THIS SIZE OF ENGINE. AN ESTIMATION OF YEARLY DISTRIBUTION OF KILOWATT-HOURS WHICH CAN BE PRODUCED BY THE SYSTEM HAS BEEN MADE BASED ON SOLAR INSOLATION DATA OF BARODA STATION. THE DETAILED DESIGNS FOR 7.5 KW AND 10 KW OPTIMIZED SYSTEMS ARE NOW READY WHEREIN THE AUXILIARIES ARE POWERED BY

THE STEAM ENGINE ITSELF, THEREBY MAKING THE UNIT INDEPENDENT AND SELF-CONTAINED.

DESCRIPTORS: DESIGN: Q1;DISTRIBUTED COLLECTOR POWER PLANTS: T1;EFFICIENCY; EVALUATION;OPERATION;PARABOLIC THOUGH COLLECTORS;PERFORMANCE; Q1;POWER RANGE 1-10 KW;RANKINE CYCLE ENGINES;SOLAR HEAT ENGINES

F-10
ACCESSION NO. 80J0028276
TITLE PROMISING DEVELOPMENTS FOR FUEL CELLS
AUTHORS HOWE, A.T.
AUTHOR AFF UNIV. OF LEEDS, ENGLAND
PUB DESC ELECTR. VEH. DEV., NO. 2, PP. 1-3
DATE JUN 1979
CATEGORIES EDB-300501
PRIMARY CAT EDB-300501
ABSTRACT DEVELOPMENT OF FUEL CELLS DEPENDS MAINLY ON FINDING A SOLID TO SEPARATE THE GASES. THE SOLID MUST CONDUCT EITHER O$SUP 2$ OR H$SUP +$ IONS VERY RAPIDLY. A SECOND DEVELOPMENT WHICH HAS OCCURRED RECENTLY IN FAVOR OF THE MEDIUM-TEMPERATURE FUEL CELL IS THE APPEARANCE OF SEVERAL NEW CATALYST SYSTEMS. MIXED OXIDES OFFERED COULD BE SINTERED ON TO A CERAMIC PROTON CONDUCTING ELECTROLYTE. THESE NEW CATALYSTS, SUCH AS SR-DOPED LACOO$SUB 3$ OPERATE MORE EFFECTIVELY AT MEDIUM TEMPERATURES, AND AT 160$SUP 0$C THIS CATALYST IS BETTER THAN PLATINUM BLACK FOR THE REDUCTION OF OXYGEN. THE THIRD WHICH IS DEVELOPING RAPIDLY IS THAT OF HYDROGEN PRODUCTION AND, MORE PARTICULARLY, STORAGE. SOME METAL HYDRIDES HAVE BEEN FOUND THAT CAN STORE UP TO 5 TIMES MORE HYDROGEN PER UNIT VOLUME THAN IS FOUND IN LIQUID HYDROGEN ITSELF. AS AN INTERMEDIATE DEVELOPMENT, IT WOULD BE POSSIBLE TO USE A FUEL CELL IN REVERSE TO PRODUCE HYDROGEN FROM WATER VAPOR, IN AN ELECTROLYSIS-CELL MODE. (MCW)
DESCRIPTORS COMPARATIVE EVALUATIONS;EFFICIENCY: Q1,Q2,D;EVALUATION: Q1;FUEL CELLS: T1,D;GRAPHS: D;HYDROGEN FUEL CELLS;HYDROGEN STORAGE; INTERNAL COMBUSTION ENGINES: T2;NUMERICAL DATA: D;RESEARCH PROGRAMS;REVIEWS;TORQUE;VELOCITY: Q1,Q2

F-11
ACCESSION NO. 80B0028275
TITLE(MONO) FUEL CELLS FOR PUBLIC UTILITY AND INDUSTRIAL POWER
EDITOR OR COMP NOYES, R. (ED.
PAGE NO 334
AVAILABILITY $42.00
PUBL LOC NOYES DATA CORPORATION, PARK RIDGE, NJ
DATE 1977
ISBN CODE ISBN 0-8155-0676-7
CATEGORIES EDB-300500
PRIMARY CAT EDB-300500
AUGMENTATION BOOK
ABSTRACT TOPICS INCLUDE: (1) TYPES OF FUEL CELLS: THEIR OPERATION AND USE; (2) ASSESSMENT OF FUELS FOR POWER GENERATION BY ELECTRIC UTILITY FUEL CELLS; (3) FUEL CELLS FOR PUBLIC UTILITY APPLICATIONS: WESTINGHOUSE STUDY; (4) FUEL CELLS FOR PUBLIC UTILITY APPLICATIONS: GENERAL ELECTRIC STUDY; (5) FUEL CELL POWER PLANT EVALUATION; AND (6) MARKETING CONSIDERATIONS. ALSO, A LISTING OF US PATENTS (WITH ABSTRACTS) SINCE 1970 THAT DEAL WITH FUEL CELLS, FUEL CELL MATERIALS, AND RELATED MATERIALS IS INCLUDED. (WHK)
DESCRIPTORS ECONOMICS;EFFICIENCY;ELECTROLYTES;FUEL CELL POWER PLANTS: M; FUEL CELLS: M;FUEL SYSTEMS;FUELS;MARKET;MARKETING RESEARCH; OPERATION;PUBLIC UTILITIES;RESEARCH PROGRAMS;REVIEWS;TECHNOLOGY ASSESSMENT

F-12
ACCESSION NO. 80X0021793
TITLE(MONO) DEVELOPMENT OF FUEL CELL TECHNOLOGY FOR VEHICULAR APPLICATIONS. ANNUAL REPORT, OCTOBER 1, 1977-SEPTEMBER 30, 1978
EDITOR OR COMP MCBREEN, J.; TAYLOR, E.J.; KORDESCH, K.V.; KISSEL, G.; KULESA, F.; SRINIVASAN, S.
CORPORATE AUTH BROOKHAVEN NATIONAL LAB., UPTON, NY (USA)
PAGE NO 108
AVAILABILITY DEP. NTIS, PC A06/MF A01.
CONTRACT NO CONTRACT EY-76-C-02-0016
DATE MAY 1979
CATEGORIES EDB-300504;300501;330300;330400;250902;250904

PRIMARY CAT EDB-300504
REPORT NO BNL--51047
ABSTRACT A SURVEY OF THE PRESENT STATE-OF-THE-ART OF FUEL CELLS AND BATTERIES SUITABLE FOR HYBRID FUEL CELL/BATTERY POWER PLANTS IS PRESENTED. ALSO GIVEN ARE A SYSTEMS STUDY ON PHOSPHORIC ACID FUEL CELLS FOR TRANSPORTATION APPLICATIONS AND THE RESULTS OF AN EXPERIMENTAL STUDY OF PHOSPHORIC ACID AND ALKALINE FUEL CELLS UNDER CONDITIONS OF INTERMITTENT OPERATION. A REVIEW OF FUEL OPTIONS AND FUEL PROCESSING FOR FUEL CELLS IS INCLUDED. (WHK)
DESCRIPTORS ACID ELECTROLYTE FUEL CELLS;CLASSIFICATION;DESIGN;EFFICIENCY; ELECTRIC BATTERIES: T4,Q3;ELECTRIC-POWERED VEHICLES: T2;FUEL CELLS: T1,Q2,Q3;FUEL ECONOMY;FUEL SYSTEMS;FUELS;HYBRID ELECTRIC-POWERED VEHICLES: T3;HYDROGEN GENERATORS;LEAD-ACID BATTERIES;NICKEL-ZINC BATTERIES;OPTIMIZATION;PERFORMANCE: Q4; REVIEWS;SOLID ELECTROLYTES;TECHNOLOGY ASSESSMENT: Q1

F-13 ACCESSION NO. 80J0021717
TITLE POWER/ENERGY: PROGRESS IN EFFICIENCY AND RELIABILITY
EDITOR OR COMP KAPLAN, G.
PUB DESC IEEE SPECTRUM, V. 16, NO. 1, PP. 56-61
DATE JAN 1979
CATEGORIES EDB-296000;200000
PRIMARY CAT EDB-296000
ABSTRACT GREATER EFFICIENCY FROM GENERATING AND TRANSMISSION EQUIPMENT, MORE EFFECTIVE USE OF POWER BY CONSUMERS, AND NEW METHODS FOR PREVENTING POWER FAILURES WERE MAJOR GOALS OF THE ELECTRIC POWER INDUSTRY IN 1978. UNDER STUDY ARE WAYS TO SPACE OUT CONSUMER DEMANDS ON POWER SYSTEMS, AS WELL AS RESEARCH ON ADVANCED POWER GENERATION THAT INCLUDES: AN ULTRAHIGH-TEMPERATURE TURBINE EMPLOYING COAL-DERIVED GAS; FUEL CELLS LARGE ENOUGH TO PROVIDE EXTRA POWER TO UTILITY GRIDS DURING PEAK-DEMAND PERIODS; A SUPERCONDUCTING GENERATOR BOASTING VIRTUALLY NO LOSSES FROM RESISTANCE HEATING; AND CONTROLLED NUCLEAR FUSION THAT WILL PRODUCE MORE ENERGY THAN IT TAKES TO SUSTAIN THE REACTION. THE EFFORTS ARE BOUND TOGETHER WITH THE NATIONAL ENERGY ACT AND PROGRESS ON THE EFFORTS IS DISCUSSED. SOME EQUIPMENT AND SOME UTILITIES ARE USING TO PUT IN PLACE TIME-OF-DAY RATE APPROACHES IS DESCRIBED. OTHER ENERGY-CONSERVING HARDWARE AND TECHNIQUES ARE BRIEFLY MENTIONED. (MCW)
DESCRIPTORS COAL GASIFICATION;COMBINED CYCLES;CONTROL SYSTEMS;EFFICIENCY: Q1,Q2;ELECTRIC POWER INDUSTRY: T2;ELECTRIC UTILITIES: T3;ENERGY CONSERVATION;FINANCIAL INCENTIVES;FUEL CELLS;NATIONAL ENERGY ACT;PEAK-LOAD PRICING: Q3;POWER GENERATION;POWER SYSTEMS: T1; POWER TRANSMISSION;RATE STRUCTURE;RELIABILITY: Q1;RESEARCH PROGRAMS;SAFETY;STABILITY;SUPERCONDUCTING GENERATORS; THERMONUCLEAR REACTORS

99/5/0000014-0000038// 23 KUD
ACCESSION NO. 80R0017461
TITLE(MONO) ORGANIC RANKINE CYCLE ENGINE TECHNOLOGY IN JAPAN. A PRELIMINARY SURVEY
CORPORATE AUTH GALAXY, INC., WASHINGTON, DC (USA)
PAGE NO 132
AVAILABILITY DEP. NTIS, PC A07/MF A01.
CONTRACT NO CONTRACT AC03-79SF10538
DATE OCT 1979
CATEGORIES EDB-425002
PRIMARY CAT EDB-425002
REPORT NO DOE/SF/10538--1
ABSTRACT THE STATE-OF-THE-ART OF THE DEVELOPMENT OF ORGANIC RANKINE CYCLE ENGINES IN JAPAN IS REVIEWED. (TFD)
DESCRIPTORS JAPAN;ORGANIC COMPOUNDS;RANKINE CYCLE ENGINES: T1;REVIEWS; TECHNOLOGY ASSESSMENT: Q1;WORKING FLUIDS

F-14 ACCESSION NO. 80K0016599
TITLE(MONO) METHODOLOGY FOR PREDICTING LONG-TERM FUEL CELL PERFORMANCE FROM SHORT-TERM TESTING. QUARTERLY TECHNICAL PROGRESS REPORT NO. 1, JUNE 6-SEPTEMBER 5, 1979
EDITOR OR COMP HOOPER, M.; MARU, H.; PATEL, D.; WARE, C.
CORPORATE AUTH ENERGY RESEARCH CORP., DANBURY, CT (USA)

PAGE NO 27
AVAILABILITY DEP. NTIS. PC A03/MF A01.
CONTRACT NO CONTRACT AC05-79ET15381
DATE 1979
CATEGORIES EDB-300502
PRIMARY CAT EDB-300502
REPORT NO DOE/ET/15381--T1
ABSTRACT THE OBJECTIVE OF THIS PROGRAM IS TO DEVELOP A METHODOLOGY FOR PREDICTING LONG-TERM FUEL CELL PERFORMANCE FROM SHORT-TERM TESTING. APPLYING THE PERTURBATION TECHNIQUE. THE TECHNIQUE WILL BE EXPERIMENTALLY AND THEORETICALLY APPLIED TO THE PHOSPHORIC ACID FUEL CELL (PAFC). DURING THE FIRST QUARTER. EFFORTS WERE CONCENTRATED ON THREE MAIN TASK AREAS: AGING MODEL DEVELOPMENT. DESIGN OF EXPERIMENTS. AND TESTING. THE DETAILS ARE PRESENTED. (WHK)
DESCRIPTORS ACID ELECTROLYTE FUEL CELLS: T2;AGING;ELECTRIC CURRENTS; ELECTROCATALYSTS;FAILURES;FORECASTING;FUEL CELLS: T1; MATHEMATICAL MODELS;PERFORMANCE;PERFORMANCE TESTING: Q1,Q2; PHOSPHORIC ACID;RELIABILITY;SERVICE LIFE;TEST FACILITIES: Q1

F-15 ACCESSION NO. 80R0016597
TITLE(MONO) 40-KW FIELD TEST POWER PLANT MODIFICATION AND DEVELOPMENT: PHASE 1. FINAL REPORT. APRIL 1. 1977-JUNE 30. 1978
EDITOR OR COMP BROWN. J.D.
CORPORATE AUTH UNITED TECHNOLOGIES CORP.. SOUTH WINDSOR. CT (USA)
PAGE NO 81
AVAILABILITY DEP. NTIS. PC A05/MF A01.
CONTRACT NO CONTRACT EC-77-C-03-1471
DATE 31 JUL 1979
CATEGORIES EDB-300501;300503
PRIMARY CAT EDB-300501
REPORT NO FCR--1019
ABSTRACT THE OBJECTIVE OF THE PHASE 1 PROGRAM WAS TO INITIATE DESIGN AND DEVELOPMENT ACTIONS THAT WOULD UPGRADE THE 40-KW FUEL CELL POWER PLANT TO A CONFIGURATION SUITABLE FOR ON-SITE INTEGRATED ENERGY SYSTEM TESTING IN A VARIETY OF FIELD APPLICATIONS. THE ENSUING MODIFICATIONS WILL IMPROVE OPERATING CAPABILITY. DURABILITY AND MAINTENANCE INTERVAL AND LEAD TO REDUCED PRODUCTION COSTS. MODIFICATION WILL BE MADE IN ALL THE POWER PLANT SUBSYSTEMS TO PROVIDE THE IMPROVED CAPABILITIES. IN THE FUEL PROCESSING SUBSYSTEM. DESIGN CHANGES WILL BE INCORPORATED TO BROADEN THE FUEL CAPABILITY TO INCLUDE VIRTUALLY ALL PIPELINE GASES AND PEAK SHAVE GASES. THIS REQUIRES THE ADDITION OF PREPROCESSOR COMPONENTS TO CHEMICALLY REDUCE OXYGEN IN PEAK-SHAVE GAS AND TO REDUCE UNSATURATED HYDROCARBONS SUCH AS PROPYLENE. THE ACTIVATED CHARCOAL FUEL TREATMENT USED ON THE PILOT POWER PLANT FOR SULFUR REMOVAL WILL BE REPLACED WITH A HYDRODESULFURIZER. A MORE ACTIVE REFORMER CATALYST WILL BE USED TO INCREASE EFFICIENCY AND PRODUCIBILITY AND REDUCE VESSEL SIZE. IN THE POWER SECTION THE LATEST CELL TECHNOLOGY WILL BE UTILIZED AND THE DIELECTRIC OIL POWER PLANT COOLING SYSTEM OF THE PILOT PLANT WILL BE REPLACED WITH A 2-PHASE WATER SYSTEM. THIS IMPROVED COOLER DESIGN WILL RESULT IN A MORE UNIFORM TEMPERATURE DISTRIBUTION POWER SECTION AND IMPROVED MAINTAINABILITY. IN THE POWER PROCESSING SUBSYSTEM THE INVERTER IS TO BE MODIFIED TO IMPROVE POWER PLANT PARALLELING CAPABILITY. FOR POWER PLANT CONTROL A MICROPROCESSOR UNIT IS TO REPLACE THE ELECTRONIC CONTROLLER OF THE PILOT POWER PLANT. TO ALLOW THE POWER PLANT TO BE OPERATED AS AN INTEGRATED ENERGY SYSTEM. A WASTE HEAT RECOVERY SYSTEM IS TO BE ADDED TO THE DESIGN. THIS SYSTEM WILL PROVIDE HEAT RECOVERY IN THE FORM OF HOT WATER.
DESCRIPTORS CATALYSTS;CONTROL SYSTEMS: Q1;COOLING SYSTEMS;DESIGN; DESULFURIZATION;ELECTROCATALYSTS;FUEL CELL POWER PLANTS: T1; FUEL SYSTEMS: Q1;HEAT RECOVERY;HYDROCARBON FUEL CELLS: T3; INVERTERS;MAINTENANCE;MANAGEMENT;METHANOL;MICROPROCESSORS; MODIFICATIONS: Q1,Q2,Q3;NAPHTHA;NATURAL GAS;NATURAL GAS FUEL CELLS: T2;PLANNING;POWER CONDITIONING CIRCUITS: Q1;POWER RANGE 10-100 KW;POWER SYSTEMS;PROPANE;REFORMER PROCESSES; SPECIFICATIONS

F-16 ACCESSION NO. 80C0008832
TITLE(MONO) MOLTEN CARBONATE FUEL CELL/COAL GASIFIER SYSTEMS
EDITOR OR COMP BLURTON, K.F.
SEC REPT NO CONF-790598--1
PAGE NO 19
CONF TITLE INSTITUTE OF GAS TECHNOLOGY SYMPOSIUM: ADVANCES IN COAL UTILIZATION TECHNOLOGY
CONF PLACE CLARKSVILLE, IN, USA
CONF DATE 14 MAY 1979
PUBL LOC INSTITUTE OF GAS TECHNOLOGY, CHICAGO, IL
DATE 1979
CATEGORIES EDB-010404;300501
PRIMARY CAT EDB-010404
ABSTRACT AN INTEGRATED MOLTEN CARBONATE FUEL CELL/COAL GASIFIER POWER PLANT IS ONE OF THE MORE PROMISING COAL-FUELED ADVANCED POWER SYSTEMS. THIS PAPER DISCUSSES THE COUPLING OF THE FUEL CELL WITH THE GASIFIER, AND IDENTIFIES THE TECHNOLOGY ISSUES WHICH NEED TO BE RESOLVED. ESTIMATES OF SYSTEM EFFICIENCY AND COST OF ELECTRICITY ARE PRESENTED.
DESCRIPTORS CARBON MONOXIDE;CARBONATES;COAL FUEL CELLS;COAL GASIFICATION: Q1;COMBINED-CYCLE POWER PLANTS: T1;COST;DESULFURIZATION; EFFICIENCY: Q1;ELECTRIC POWER;FEASIBILITY STUDIES: Q1,Q2; FLOWSHEETS;FUEL CELL POWER PLANTS: T2;FUEL GAS;GAS TURBINES; HIGH-TEMPERATURE FUEL CELLS: Q1;HYDROGEN;MOLTEN SALTS;POWER GENERATION;PURIFICATION;SELEXOL PROCESS;STEAM TURBINES; SYNTHESIS GAS;TEXACO GASIFICATION PROCESS: T;U-GAS PROCESS: T; WASTE HEAT UTILIZATION

F-17 ACCESSION NO. 80H0005117
TITLE(MONO) DEVELOPMENT OF SULFUR-TOLERANT COMPONENTS FOR SECOND-GENERATION MOLTEN CARBONATE FUEL CELLS
EDITOR OR COMP CLAAR, T.D.; MARIANOWSKI, L.G.; SAMMELLS, A.F.
CORPORATE AUTH INSTITUTE OF GAS TECHNOLOGY, CHICAGO, IL (USA)
PAGE NO 139
AVAILABILITY DEP. NTIS, PC A07/MF A01.
DATE JUL 1979
CATEGORIES EDB-300503;300502
PRIMARY CAT EDB-300503
REPORT NO EPRI-EM--1114
ABSTRACT FUTURE LARGE-SCALE FUEL CELL POWER PLANT APPLICATIONS WILL REQUIRE THE USE OF HYDROCARBON FEEDS SUCH AS COAL, HEAVY OILS, AND DISTILLATES CONTAINING SULFUR. AS A RESULT, DEPENDING ON THE FUEL CONVERSION AND CLEANUP PROCESSES USED, VARYING AMOUNTS OF SULFUR WILL APPEAR IN THE FUEL CELL FEED. BECAUSE BOTH THE COST AND COMPLEXITY OF THE TOTAL PLANT INCREASE AS THE REMOVAL LEVELS INCREASE, IT IS ESSENTIAL TO IDENTIFY THE GAS PURITY REQUIREMENTS OF MOLTEN CARBONATE FUEL CELLS. THEREFORE, THE OBJECTIVES OF THIS STUDY ARE: (1) TO ESTABLISH THE PERFORMANCE AND ENDURANCE CHARACTERISTICS OF MOLTEN CARBONATE FUEL CELLS AS A FUNCTION OF SULFUR CONTAMINANTS IN BOTH FUEL AND OXIDANT FEED GASES; (2) TO IDENTIFY THE SULFUR TOLERANCE OF CELL MATERIALS; AND (3) TO ESTABLISH CELL PERFORMANCE AS A FUNCTION OF GAS COMPOSITION AT 5 AND 10-ATM PRESSURE. CELL TESTS USING A VARIETY OF SULFUR CONCENTRATIONS INDICATED THAT THE SULFUR TOLERANCE OF PRESENT MOLTEN CARBONATE FUEL CELLS IS BELOW 10 PPM IN THE INCOMING FEED GASES. BOTH CELL PERFORMANCE LOSSES AND ENDURANCE LIMITATIONS WERE OBSERVED AT THESE LEVELS AND THEY WERE SHOWN TO OCCUR PRIMARILY ON THE ANODE SIDE OF THE CELL. THE PERFORMANCE LOSSES ARE DUE TO A COMBINATION OF STRUCTURAL CHANGES IN THE ANODE AND REDUCED MASS TRANSFER CHARACTERISTICS OF THE CARBONATE MELT CAUSED BY INTERACTIONS BETWEEN THE CARBONATE MELT AND THE SULFUR SPECIES. THE ENDURANCE LIMITATIONS ARE DUE TO CORROSION OF THE CURRENT COLLECTOR AND OTHER METALLIC COMPONENTS THAT WERE SHOWN TO BE MORE SEVERELY CORRODED IN THE PRESENCE OF THE SULFUR-CONTAINING GASES. POTENTIALLY MORE SULFUR-TOLERANT MATERIALS WERE IDENTIFIED IN SUPPLEMENTARY SCREENING TESTS. (WHK)
DESCRIPTORS ANODES;CARBONATES;CATHODES;CHEMICAL COMPOSITION;COAL FUEL CELLS: T3;CORROSION;CORROSIVE EFFECTS;ELECTRODES;FUELS; HIGH-TEMPERATURE FUEL CELLS: T1;HYDROCARBON FUEL CELLS: T2; IMPURITIES: Q1,Q2,Q3;MASS TRANSFER;MATERIALS;MATERIALS TESTING: Q1,Q2,Q3;MOLTEN SALTS;NICKEL;PERFORMANCE;PERFORMANCE TESTING; POISONING;QUANTITY RATIO;SCREENING;SERVICE LIFE;STAINLESS

STEELS;SULFUR

99/5/0000014-0000038// 28

ACCESSION NO.	80J0001597
TITLE	EFFECT OF SUBSTRUCTURE ON THE MECHANICAL PROPERTIES OF FE-NI-CO-C ALLOYS
AUTHORS	RAGHAVAN, M.); THOMAS, G.
AUTHOR AFF	EXXON RESEARCH AND ENGINEERING CO., LINDEN, N
PUB DESC	METALL. TRANS., A. V. 10A, NO. 11, PP. 1665-1673
DATE	NOV 1979
CATEGORIES	EDB-360103
PRIMARY CAT	EDB-360103
ABSTRACT	THE EFFECT OF TRANSFORMATION SUBSTRUCTURE (LATH OR TWINNED PLATES) AND ITS SUBSEQUENT MODIFICATION OF CARBIDE DISTRIBUTION DURING TEMPERING ON THE MECHANICAL PROPERTIES WAS INVESTIGATED IN FE-NI-CO ALLOYS WITH AND WITHOUT 0.1 PCT CARBON. THE MORPHOLOGY AND SUBSTRUCTURE OF CARBON FREE AND 0.1 PCT CARBON FE-NI-CO MARTENSITES DO NOT HAVE A SIGNIFICANT EFFECT ON FRACTURE TOUGHNESS. THE TRANSFORMATION SUBSTRUCTURE BY ITSELF DOES NOT CONTROL THE DEFORMATION MODE OF THESE MARTENSITES. BASED ON A PREVIOUSLY SUGGESTED MODEL ON FACTORS AFFECTING THE MODE OF DEFORMATION, THE NEED FOR SUBSTRUCTURE CONTROL TO MAINTAIN DESIRABLE MECHANICAL PROPERTIES OF LOW ALLOY HIGH STRENGTH STEELS IS AGAIN EMPHASIZED.
DESCRIPTORS	CARBIDES;CARBON ADDITIONS;CHARPY TEST;COBALT ALLOYS: T3; DEFORMATION;IRON BASE ALLOYS: T1;MARTENSITE;MECHANICAL PROPERTIES: Q1,Q2,Q3;MODIFICATIONS;MORPHOLOGY;NICKEL ALLOYS: T2; NUCLEATION;PRECIPITATION;QUENCHING;TWINNING

F-18

ACCESSION NO.	79C0136762
REPORT NO.PAGE	LA--7270-C PP. 73-74
TITLE	MARKETABILITY - AN OVERVIEW
AUTHORS	RAHM, A.M.
TITLE(MONO)	PROCEEDINGS OF THE FUEL CELL IN TRANSPORTATION APPLICATIONS WORKSHOP
EDITOR OR COMP	MCCORMICK, B.; BOBBETT, R.; SRINIVASAN, S.; MCBREEN, J. (EDS.)
SEC REPT NO	CONF-770892--
PAGE NO	73-74
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONF TITLE	FUEL CELL POWERED VEHICLE WORKSHOP
CONF PLACE	LOS ALAMOS, NM, USA
CONF DATE	15 AUG 1977
DATE	JUL 1978
CATEGORIES	EDB-300504;330400
PRIMARY CAT	EDB-300504
REPORT NO	LA--7270-C
ABSTRACT	THE FACTORS INVOLVED IN DEVELOPMENT OF A MARKETABLE METHANOL FUEL CELL/BATTERY HYBRID ELECTRIC-POWERED AUTOMOBILE ARE BRIEFLY DISCUSSED. CAPITAL AND OPERATING COSTS, RELIABILITY, PRODUCT LIFE, SAFETY, MASS PRODUCTION MANUFACTURING CAPABILITY WITH PREDICTABLE PERFORMANCE, AND INDUSTRY ACCEPTANCE ARE MENTIONED. (WHK)
DESCRIPTORS	ALCOHOL FUEL CELLS: Q1;AUTOMOBILES;COMMERCIALIZATION: Q1;COST; ELECTRIC BATTERIES;HYBRID ELECTRIC-POWERED VEHICLES: T1; MANUFACTURING;MARKET;METHANOL;RELIABILITY;SAFETY;SERVICE LIFE

F-19

ACCESSION NO.	79C0136756
REPORT NO.PAGE	LA--7270-C PP. 31-33
TITLE	EPRI FUEL CELL PROGRAM
AUTHORS	FICKETT, A.
AUTHOR AFF	ELECTRIC POWER RESEARCH INST., PALO ALTO, CA
TITLE(MONO)	PROCEEDINGS OF THE FUEL CELL IN TRANSPORTATION APPLICATIONS WORKSHOP
EDITOR OR COMP	MCCORMICK, B.; BOBBETT, R.; SRINIVASAN, S.; MCBREEN, J. (EDS.)
SEC REPT NO	CONF-770892--
PAGE NO	31-33
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONF TITLE	FUEL CELL POWERED VEHICLE WORKSHOP
CONF PLACE	LOS ALAMOS, NM, USA
CONF DATE	15 AUG 1977
DATE	JUL 1978
CATEGORIES	EDB-300501

PRIMARY CAT	EDB-300501
REPORT NO	LA--7270-C
ABSTRACT	THE EPRI FUEL CELL PROGRAM IS NOW THREE YEARS OLD. HAVING BEEN INITIATED BY THE TRANSFER OF PROJECT MANAGEMENT RESPONSIBILITY FOR ADVANCED FUEL CELL TECHNOLOGY FROM AN EEI STEERING COMMITTEE TO EPRI'S TECHNICAL STAFF (RP114). DURING THIS PERIOD. CRITICAL ISSUES. BOTH TECHNICAL AND NONTECHNICAL. HAVE BEEN IDENTIFIED. A COMPREHENSIVE FUEL CELL PROGRAM TO ADDRESS THESE ISSUES HAS BEEN FORMULATED.
DESCRIPTORS	DESIGN;ECONOMICS;EPRI;FUEL CELLS: T1;RESEARCH PROGRAMS: Q1; SERVICE LIFE

F-20

ACCESSION NO.	79R0131047
TITLE(MONO)	FEASIBILITY OF COGENERATION APPLICATION OF A 4.8-MW FUEL CELL POWER PLANT AT A SANTA CLARA, CALIFORNIA PAPER MILL. FINAL REPORT
EDITOR OR COMP	CRINER, D.E.
CORPORATE AUTH	BURNS AND MCDONNELL ENGINEERING CO., KANSAS CITY, MO (USA)
PAGE NO	300
AVAILABILITY	DEP. NTIS, PC A13/MF A01.
CONTRACT NO	CONTRACT ET-78-C-03-2189
DATE	JUL 1979
CATEGORIES	EDB-300501;200105;290800
PRIMARY CAT	EDB-300501
REPORT NO	SAN--2189-T1
ABSTRACT	THIS STUDY EVALUATED THE FEASIBILITY OF EMPLOYING A 4.8-MW FUEL CELL POWER PLANT IN A COGENERATION MODE. THE PROPOSED SITE FOR THE POWER PLANT IS AT A SANTA CLARA, CALIFORNIA, RECYCLED PAPER MILL OWNED BY THE CONTAINER CORPORATION OF AMERICA. WAYS FOR UTILIZING THE WASTE HEAT FROM THE FUEL CELL WITHIN THE PAPER MILL WERE STUDIED. SEVERAL USES WERE IDENTIFIED WHICH WOULD REDUCE THE AMOUNT OF PROCESS STEAM NOW GENERATED BY CONVENTIONAL FOSSIL-FUELED BOILERS IN THE PAPER MILL. THE ELECTRICAL ENERGY FROM THE FUEL CELL COULD BE FED TO THE MUNICIPAL ELECTRIC SYSTEM OWNED BY THE CITY OF SANTA CLARA OR COULD BE USED DIRECTLY BY THE PAPER MILL, DEPENDING UPON THE FORM OF OWNERSHIP FOR THE FUEL CELL. IN ADDITION TO ASSESSING OWNERSHIP ALTERNATIVES FOR THE FUEL CELL POWER PLANT, POTENTIAL ARRANGEMENTS FOR OPERATION AND MAINTENANCE OF THE PLANT WERE STUDIED. ALSO, THE PROJECTED COST AND AVAILABILITY OF ALTERNATIVE FUELS FOR THE FUEL CELL WERE EXAMINED. ECONOMIC ANALYSES WERE PERFORMED FOR SEVERAL SCENARIOS INVOLVING DIFFERENT FUELS AND OWNERSHIP ARRANGEMENTS. BREAKEVEN CAPITAL COSTS FOR THE FUEL CELL POWER PLANT WERE COMPUTED FOR THE VARIOUS SCENARIOS. SENSITIVITY STUDIES WERE PERFORMED TO DETERMINE THE IMPACT OF VARIATIONS IN ASSUMED BASE VALUES FOR FUEL PRICE, ELECTRIC RATES, AND OTHER PARAMETERS. TOTAL ENERGY SAVINGS RESULTING FROM OPERATION OF THE FUEL CELL POWER PLANT AND THE POTENTIAL OPERATIONAL IMPACT OF THE FUEL CELL POWER PLANT ON THE CITY OF SANTA CLARA ELECTRIC SYSTEM AND CCA PLANT WERE ALSO EVALUATED. THE ENVIRONMENTAL IMPLICATIONS OF THE FUEL CELL POWER PLANT WERE ASSESSED IN TERMS OF THE NET CHANGES IN AIR EMISSIONS FOR PARTICULATES, SULFUR DIOXIDE, AND OXIDES OF NITROGEN WHICH WOULD OCCUR AT THE PAPER MILL PLANT SITE. AS PART OF THE STUDY, A PROPOSED DEMONSTRATION PROGRAM WAS DEVELOPED FOR ACTUALLY INSTALLING THE FUEL CELL POWER PLANT AT THE SANTA CLARA SITE.
DESCRIPTORS	AIR POLLUTION ABATEMENT;AUXILIARY SYSTEMS;AVAILABILITY; CALIFORNIA;CO-GENERATION: Q1;COST;DEMONSTRATION PROGRAMS; DIAGRAMS;DUAL-PURPOSE POWER PLANTS: T2,Q3;ECONOMIC ANALYSIS; ECONOMICS;ENVIRONMENTAL IMPACTS;FEASIBILITY STUDIES: Q1,Q2; FORECASTING;FUEL CELL POWER PLANTS: T1,Q2,Q3;FUELS;HYDROCARBON FUEL CELLS;INSTALLATION;NAPHTHA;NATURAL GAS;NATURAL GAS FUEL CELLS;OWNERSHIP;PAPER INDUSTRY: T3;POWER RANGE 1-10 MW;PRICES; PROCESS HEAT;RECYCLING;SENSITIVITY ANALYSIS;STEAM GENERATORS; WASTE HEAT UTILIZATION

F-21 ACCESSION NO. 79C0123740
TITLE(MONO) MOLTEN CARBONATE FUEL CELL SYSTEMS DEVELLOPMENT PROGRAM
EDITOR OR COMP BORYS, S.S.; ACKERMAN, J.P.
CORPORATE AUTH ARGONNE NATIONAL LAB., IL (USA)
PAGE NO 7
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT W-31-109-ENG-38
CONF TITLE 14. INTERSOCIETY ENERGY CONVERSION CONFERENCE
CONF PLACE BOSTON, MA, USA
CONF DATE 5 AUG 1979
DATE 1979
CATEGORIES EDB-300501
PRIMARY CAT EDB-300501
REPORT NO CONF-790803--53
ABSTRACT THE OBJECTIVE OF THE US DEPARTMENT OF ENERGY MOLTEN CARBONATE FUEL CELL (MCFC) SYSTEMS DEVELOPMENT PROGRAM IS TO IMPLEMENT THE EARLIEST FEASIBLE COMMERCIAL USE OF MCFC POWER PLANTS OPERATING ON COAL; IMPLEMENTATION WILL PROVIDE BENEFITS IN COST OF ELECTRICITY, ENVIRONMENTAL QUALITY, AND RESOURCE CONVERSATION. MOLTEN CARBONATE FUEL CELLS OPERATING AT HIGH TEMPERATURE (APPROX. 925 K) YIELD RAPID KINETICS, FUEL FLEXIBILITY, AND HIGH GRADE WASTE HEAT. EMISSIONS OF SULFUR OXIDES, NITROGEN OXIDES, AND PARTICULATES FROM A MCFC POWER PLANT WITH AN INTEGRATED COAL GASIFIER WILL BE WELL BELOW ANY KNOWN COMPETITIVE TECHNOLOGY. PRIMARY AREAS OF CELL DEVELOPMENT ARE SCALEUP, LIFETIME AND CYCLING CAPABILITIES. KEY MILESTONES FOR THE DEVELOPMENT OF MCFC POWER PLANTS ARE (1) OPERATION OF A PROTOTYPE FUEL CELL ASSEMBLY (STACK) ON SIMULATED GAS BY LATE 1982, (2) OPERATION OF A PROTOTYPE STACK ON COAL GASIFIER PRODUCT GAS BY LATE 1983, (3) OPERATION OF AN INTEGRATED MULTI-MW TEST FACILITY BY MID-1985. OPERATION OF A BASELOAD POWER PLANT OF SEVERAL HUNDRED MEGAWATTS CAN BE ACHIEVED BY 1990.
DESCRIPTORS CARBONATES;COAL FUEL CELLS;COAL GASIFICATION;COST;FUEL CELL POWER PLANTS;HIGH-TEMPERATURE FUEL CELLS: T1;MOLTEN SALTS; NATIONAL PROGRAM PLANS;OPERATION;PERFORMANCE;RESEARCH PROGRAMS: Q1;SCALING LAWS;SERVICE LIFE;TECHNOLOGY ASSESSMENT

F-22 ACCESSION NO. 79J0123728
TITLE DIRECT ENERGY CONVERSION DEVICES AND THEIR POTENTIAL NAVAL APPLICATIONS
AUTHORS WU, C.; FINE, J.M.; CHI, L.K.
AUTHOR AFF US NAV ACAD
PUB DESC NAV. ENG. J., V. 91, NO. 1, PP. 87-96
DATE FEB 1979
CATEGORIES EDB-300000
PRIMARY CAT EDB-300000
ABSTRACT DIRECT ENERGY CONVERSION DEVICES MAY BE USED AS PRIME MOVERS, REFRIGERATING MACHINES, ET CETERA, AND ARE ENDOWED WITH CHARACTERISTICS WELL SUITED TO DIVERSE NAVAL APPLICATIONS. DESPITE THIS, NOT MUCH EFFORT HAS BEEN INVESTED IN THE U.S. NAVY IN THEIR DEVELOPMENT. THERE IS AN URGENT NEED FOR SUBSTANTIAL FUNDAMENTAL WORK IN THIS AREA TO BE INITIATED. DEVELOPMENTS OF THERMOELECTRIC CONVERTERS, THERMIONIC GENERATORS, PHOTOVOLTAIC CELLS, MAGNETOHYDRODYNAMIC (MHD) SYSTEMS, AND FUEL CELLS ARE SURVEYED. A COMPARISON BETWEEN CONVENTIONAL ENERGY CONVERSION AND DIRECT ENERGY CONVERSION IN SIZE, WEIGHT, AND EFFICIENCY IS MADE. POTENTIAL APPLICATION OF THESE ENERGY CONVERSION DEVICES FOR NAVAL USE IS STUDIED.
DESCRIPTORS COMPARATIVE EVALUATIONS;DIRECT ENERGY CONVERTERS: T1;FUEL CELLS; MHD GENERATORS;MILITARY EQUIPMENT;PHOTOVOLTAIC CELLS;REVIEWS: Q1;TECHNOLOGY ASSESSMENT;THERMIONIC CONVERTERS;THERMOELECTRIC GENERATORS;USES

F-23

ACCESSION NO.	79R0118133
TITLE(MONO)	ALTERNATE ELECTROLYTE COMPOSITIONS FOR MOLTEN CARBONATE FUEL CELLS
EDITOR OR COMP	ONG, E.T.; DONADO, R.A.; LI, C.T.; CLAAR, T.D.
CORPORATE AUTH	INSTITUTE OF GAS TECHNOLOGY, CHICAGO, IL (USA)
PAGE NO	14
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EM-78-C-03-1735
CONF TITLE	THE MOLTEN CARBONATE FUEL CELL WORKSHOP
CONF PLACE	OAK RIDGE, TN, USA
CONF DATE	31 OCT 1978
DATE	1978
CATEGORIES	EDB-300503;360603
PRIMARY CAT	EDB-300503
REPORT NO	CONF-7810130—4
ABSTRACT	PROPERTIES OF THE LI$SUB 2$CO$SUB 3$-NA$SUB 2$CO$SUB 3$-K$SUB 2$CO$SUB 3$ ELECTROLYTE SYSTEM RELATED TO CELL PERFORMANCE (SUCH AS ELECTRICAL CONDUCTIVITY, GAS SOLUBILITY AND DIFFUSIVITY, SURFACE TENSION, AND VISCOSITY) AND CELL ENDURANCE (SUCH AS CORROSIVITY, VAPOR LOSSES AND COMPATIBILITY WITH TILE SUPPORT MATERIAL) ARE REVIEWED FOR THE PURPOSE OF OPTIMIZING THE ELECTROLYTE COMPOSITION. MOST RECENT CELL PERFORMANCE DATA ON DIFFERENT ELECTROLYTE COMPOSITIONS ARE PRESENTED AND CORRELATED WITH THE CORRESPONDING ELECTROLYTE PROPERTIES. AN OPTIMUM ELECTROLYTE COMPOSITION REGIME HAS BEEN IDENTIFIED AND FACTORS THAT AFFECT BOTH CELL PERFORMANCE AND ENDURANCE ARE DISCUSSED.
DESCRIPTORS	CARBONATES: D;CHEMICAL COMPOSITION: D;COMPATIBILITY: D; CORROSION RESISTANCE: D;CORROSIVE EFFECTS: D;CURRENT DENSITY; DATA COMPILATION: D;DIFFUSION: D;ELECTRIC CONDUCTIVITY: D; ELECTROLYTES: Q1,D;GRAPHS: D;HIGH TEMPERATURE: D; HIGH-TEMPERATURE FUEL CELLS: T1,D;LITHIUM CARBONATES: T2,D; MIXTURES: D;MOLTEN SALTS: D;OPTIMIZATION: D;PERFORMANCE; PHYSICAL PROPERTIES: Q2,Q3,Q4,D;POLARIZATION: D;POTASSIUM CARBONATES: T4,D;SERVICE LIFE;SODIUM CARBONATES: T3,D; SOLUBILITY: D;SURFACE TENSION: D;TABLES: D;TEMPERATURE DEPENDENCE: D;VAPOR PRESSURE: D;VISCOSITY: D

F-24

ACCESSION NO.	79R0118062
TITLE(MONO)	ALASKA REGIONAL ENERGY RESOURCES PLANNING PROJECT, PHASE 2: COAL, HYDROELECTRIC, AND ENERGY ALTERNATIVES. VOLUME III. ALASKA'S ALTERNATIVE ENERGIES AND REGIONAL ASSESSMENT INVENTORY UPDATE
CORPORATE AUTH	ALASKA DEPT. OF COMMERCE AND ECONOMIC DEVELOPMENT, JUNEAU (USA)
PAGE NO	326
AVAILABILITY	DEP. NTIS, PC A15/MF A01.
CONTRACT NO	CONTRACT EY-77-C-06-1002
DATE	JAN 1979
CATEGORIES	EDB-299000;300500;140504;170000;150000;130000
PRIMARY CAT	EDB-299000
REPORT NO	RLO--1002-T2(VOL.3)
ABSTRACT	THE ALASKA REGIONAL ENERGY RESOURCES PLANNING PROJECT IS PRESENTED IN THREE VOLUMES. THIS VOLUME, VOL. III, CONSIDERS ALTERNATIVE ENERGIES AND THE REGIONAL ASSESSMENT INVENTORY UPDATE. THE INTRODUCTORY CHAPTER, CHAPTER 12, EXAMINES THE HISTORICAL BACKGROUND, CURRENT TECHNOLOGICAL STATUS, ENVIRONMENTAL IMPACT, APPLICABILITY TO ALASKA, AND SITING CONSIDERATIONS FOR A NUMBER OF ALTERNATIVE SYSTEMS. ALL OF THE SYSTEMS CONSIDERED USE OR COULD USE RENEWABLE ENERGY RESOURCES. THE CHAPTERS THAT FOLLOW ARE ENTITLED: VERY SMALL HYDROPOWER (ABOUT 12 KW OR LESS FOR RURAL AND REMOTE VILLAGES); LOW-TEMPERATURE GEOTHERMAL SPACE HEATING; WIND; FUEL CELLS; SITING CRITERIA AND PRELIMINARY SCREENING OF COMMUNITIES FOR ALTERNATE ENERGY USE; WOOD RESIDUES; WASTE HEAT; AND REGIONAL ASSESSMENT INVENTORY UPDATE. (MCW)
DESCRIPTORS	ALASKA: T1,D;DATA COMPILATION: D;ENVIRONMENTAL EFFECTS;FUEL CELLS: T5;GEOTHERMAL ENERGY: T2;LOW-HEAD HYDROELECTRIC POWER PLANTS: T3;REGIONAL ANALYSIS;RENEWABLE ENERGY SOURCES: Q1,D; RESOURCE POTENTIAL: Q2,Q3,Q4,Q5,Q6;RURAL AREAS;SITE SELECTION; SPACE HEATING;TABLES: D;TECHNOLOGY ASSESSMENT;WASTE HEAT;WASTE HEAT UTILIZATION: Q1;WIND POWER: T4;WOOD WASTES: T6

F-25

ACCESSION NO.	79C0111632
TITLE	INCENTIVES AND REQUIREMENTS FOR GASIFICATION-BASED POWER SYSTEMS
AUTHORS	HOLT, N.A.
AUTHOR AFF	ELECTRIC POWER RESEARCH INST., PALO ALTO, CA
TITLE(MONO)	ENERGY TECHNOLOGY V: CHALLENGES TO TECHNOLOGY
EDITOR OR COMP	HILL, R.F. (ED.)
SEC REPT NO	CONF-780222--
PAGE NO	588-605
CONF TITLE	5. ENERGY TECHNOLOGY CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	27 FEB 1978
PUBL LOC	GOVERNMENT INSTITUTES, INC., WASHINGTON, DC
DATE	1978
CATEGORIES	EDB-294001;010404;296001;200102
PRIMARY CAT	EDB-294001
ABSTRACT	THE MAIN INCENTIVES FOR THE USE OF GASIFICATION-BASED POWER SYSTEMS OVER OTHER COAL-BASED GENERATING SYSTEMS SUCH AS DIRECT COAL FIRING WITH STACK-GAS SCRUBBING ARE: MARKEDLY REDUCED EMISSIONS; BETTER RESOURCE UTILIZATION (COAL, WATER, LAND); AND COMPETITIVE CAPITAL COST AND COST OF POWER. THE RESULTS OF A SERIES OF ECONOMIC STUDIES CONDUCTED BY FLUOR CORP. FOR EPRI INDICATE THAT THE CAPITAL COST OF INTEGRATED-GASIFICATION COMBINED-CYCLE POWER PLANTS ARE 700 TO 850 $/KW IN MID 1976 DOLLARS WITH HEAT RATES IN THE RANGE 8400 TO 9000 BTU/KWH. OF ALL THE POTENTIAL USES OF COAL GASIFICATION IN POWER SYSTEMS, THIS APPEARS THE MOST ATTRACTIVE. COAL GASIFICATION USES IN POWER SYSTEMS CONSIDERED WERE: CLEAN FUEL GAS FOR COMBUSTION TURBINE COMBINED CYCLE, REGENERATIVE OR FUEL-CELL SYSTEMS; CLEAN FUEL GAS FOR DIRECT FIRING IN STEAM BOILERS; SYNTHESIS GAS AS A SOURCE OF CLEAN LIQUID FUELS FOR INTERMEDIATE- AND PEAKING -LOAD DUTIES ON GAS TURBINES AND FUEL CELLS; AND AS A SOURCE OF HYDROGEN FOR COAL LIQUEFACTION AND REGENERATIVE STACK-GAS-SCRUBBING PROCESSES. THE DESIRABLE GASIFIER CHARACTERISTICS FOR INTEGRATION IN GASIFICATION COMBINED-CYCLE SYSTEMS ARE SIMPLICITY, FEEDSTOCK FLEXIBILITY, MINIMUM DOWNSTREAM GAS PROCESSING, AND COMPATIBILITY WITH POWER-GENERATION REQUIREMENTS. THE STATUS OF THE GASIFIER TECHNOLOGY IS REVIEWED. (MCW)
DESCRIPTORS	COAL GASIFICATION: Q1;COMBINED CYCLES;COMBINED-CYCLE POWER PLANTS: T1;COMPARATIVE EVALUATIONS;COMPETITION;DESIGN; ECONOMICS: Q1;ENVIRONMENTAL IMPACTS;EPRI;FUEL CELLS;GAS TURBINES;RELIABILITY

F-26

ACCESSION NO.	79A0105312
TITLE(MONO)	ADVANCED FUEL CELL DEVELOPMENT. PROGRESS REPORT, JULY--SEPTEMBER 1978
EDITOR OR COMP	FINN, P.A.; KINOSHITA, K.; KUCERA, G.H.; PIERCE, R.D.; SIM, J.W.
CORPORATE AUTH	ARGONNE NATIONAL LAB., IL (USA)
PAGE NO	37
AVAILABILITY	P 03/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
DATE	MAY 1979
CATEGORIES	EDB-300503;300501
PRIMARY CAT	EDB-300503
AUGMENTATION	$GAMMA$-LIALO$SUB 2$ ELECTROLYTE
REPORT NO	ANL--78-96
ABSTRACT	THIS REPORT DESCRIBES ADVANCED FUEL CELL RESEARCH AND DEVELOPMENT ACTIVITIES AT ARGONNE NATIONAL LABORATORY (ANL) DURING THE PERIOD JULY--SEPTEMBER 1978. THESE EFFORTS HAVE BEEN DIRECTED TOWARD UNDERSTANDING AND IMPROVING THE COMPONENTS OF MOLTEN-CARBONATE-ELECTROLYTE FUEL CELLS OPERATED AT TEMPERATURES NEAR 925 K. THE PRIMARY FOCUS OF THIS WORK HAS BEEN THE DEVELOPMENT OF ELECTROLYTE STRUCTURES THAT HAVE GOOD ELECTROLYTE RETENTION AND MECHANICAL PROPERTIES AS WELL AS LONG TERM STABILITY, AND ON DEVELOPING METHODS OF SYNTHESIS AMENABLE TO MASS PRODUCTION. THE CHARACTERIZATION OF THESE STRUCTURES AND THEIR STABILITY IS AN INTEGRAL PART OF THIS EFFORT. SYNTHESIS STUDIES HAVE CONCENTRATED ON THE USE OF LOW-COST STARTING MATERIAL TO SYNTHESIZE $GAMMA$-LIALO$SUB 2$, THE MOST STABLE ALLOTROPE OF LIALO$SUB 2$ FOR THE FUEL CELL CONDITIONS. THERMAL STABILITY AND THERMOMECHANICAL TESTS WERE PERFORMED ON ELECTROLYTE MIXTURES TO DETERMINE THE EFFECT OF CELL OPERATING CONDITIONS ON ELECTROLYTE TILE LONGEVITY. A SQUARE CELL (10.6

CM) WITH AN ELECTROLYTE TILE CONTAINING $GAMMA$-LIALO$SUB 2$ WAS TESTED. THIS TILE WAS REINFORCED BY A WIRE SCREEN. POST-TEST EXAMINATION OF THIS CELL AFTER 1000 H OF OPERATION SHOWED THAT THE REINFORCED TILE WAS CONSIDERABLY STRONGER THAN UN-REINFORCED TILES. FUTURE CELLS WILL UTILIZE TILES WITH METAL SCREEN REINFORCEMENT.

DESCRIPTORS: ALUMINATES;CARBONATES;DESIGN;ELECTROLYTES: Q1;FABRICATION; HIGH-TEMPERATURE FUEL CELLS: M1;LITHIUM COMPOUNDS;MOLTEN SALTS; PARTICLE SIZE;PERFORMANCE TESTING: Q1;PRODUCTION;RESEARCH PROGRAMS;SERVICE LIFE;STABILITY

F-27

ACCESSION NO.: 79J0099732
TITLE: NEW FLUID BATTERY PROMISES CHEAPER ELECTRICITY STORAGE
PUB DESC: PUBLIC UTIL. FORTN., V. 103, NO. 9, PP. 65-66, 68
DATE: 26 APR 1979
CATEGORIES: EDB-290700;200107
PRIMARY CAT: EDB-290700
ABSTRACT: THE REDOX ENERGY STORAGE SYSTEM PROMISES MAJOR COST REDUCTIONS IN THE STORING OF ELECTRICAL ENERGY AS WELL AS LONG-TERM RELIABILITY AND MINIMAL ENVIRONMENTAL IMPACT. THE NEW NASA SYSTEM COULD BE SCALED UP IN THE NEXT SEVERAL YEARS, DEPENDING ON FUNDING, TO PROVIDE ELECTRIC POWER COMPANIES WITH AN EFFICIENT MEANS OF LOAD LEVELING - THE STORING OF THOUSANDS OF KWH OF ENERGY DURING LOW DEMAND PERIODS FOR USE LATER DURING PERIODS OF MAXIMUM POWER CONSUMPTION. MORE IMMEDIATELY, REDOX SYSTEMS IN THE KILOWATT RANGE COULD HELP TO SPEED THE GROWTH OF SOLAR ELECTRIC (PHOTOVOLTAIC) AND WIND-ENERGY SYSTEMS WHERE THE COST OF ELECTRICAL STORAGE HAS BEEN AN IMPORTANT CONSIDERATION SINCE STORAGE IS NECESSARY FOR THE TIMES THE SUN IS NOT SHINING OR THE WIND IS NOT BLOWING.
DESCRIPTORS: COMPARATIVE EVALUATIONS;ECONOMICS: Q1;EFFICIENCY;ELECTRIC UTILITIES: T2;ENVIRONMENTAL IMPACTS;EVALUATION;LEAD-ACID BATTERIES;LOAD MANAGEMENT;OFF-PEAK ENERGY STORAGE: T3; PHOTOVOLTAIC POWER PLANTS;REDOX FUEL CELLS: T1,Q2,Q3; RELIABILITY;WIND POWER PLANTS

F-28

ACCESSION NO.: 79R0099640
TITLE(MONO): POWER SUPPLIES FOR ARCTIC RADIO REPEATER SYSTEMS
EDITOR OR COMP: NAGY, G.D.
CORPORATE AUTH: DEFENCE RESEARCH ESTABLISHMENT, OTTAWA, ONTARIO (CANADA)
PAGE NO: 50
AVAILABILITY: Y A03/MF A01.
DATE: SEP 1978
CATEGORIES: EDB-250902;300502;300302;070302;170601
PRIMARY CAT: EDB-250902
REPORT NO: AD-A--061609
ABSTRACT: THIS FEASIBILITY STUDY ASSESSES VARIOUS LONG-LIVED, SELF-CONTAINED 30-WATT POWER SUPPLIES FOR AN ARCTIC RADIO REPEATER SYSTEM. THE STUDY INVOLVES A REVIEW OF THE STATE OF THE ART, AVAILABILITY AND COST OF FIVE CANDIDATE SYSTEMS: BATTERIES, FUEL CELLS, RADIOISOTOPIC THERMOELECTRIC GENERATORS, FUELED THERMOELECTRIC GENERATORS AND WINDMILL-BATTERY SYSTEMS. THE ABOVE FIVE CANDIDATES WERE ALSO ASSESSED AS STANDBY POWER UNITS. RELIABILITY, SERVICE AND MAINTENANCE REQUIREMENTS ARE CONSIDERED SINCE THE APPLICATION CALLS FOR ONE YEAR UNATTENDED OPERATION AND SERVICING BY LIGHT HELICOPTER ON A SINGLE ANNUAL FLIGHT FOR ALL SITES. ONLY ZINC/AIR BATTERIES WITH LEAD/ACID BATTERIES FOR THE STANDBY SYSTEM ARE AVAILABLE NOW. THEIR COST IS MODERATE, BUT ZINC/AIR CELLS ARE HEAVY AND MUST BE REPLACED EACH YEAR. OTHER SYSTEMS COULD BE AVAILABLE IN THE 1980'S BUT THEY WOULD REQUIRE VARIOUS AMOUNTS OF DEVELOPMENT WORK AND EVALUATION IN AN ARCTIC ENVIRONMENT. RECOMMENDATIONS AND PRIORITIES FOR DEVELOPMENT OF THE SYSTEMS WHICH COULD REPLACE THE ZINC/AIR CELLS AT A LATER DATE ARE GIVEN. (AUTHOR)
DESCRIPTORS: ARCTIC REGIONS;COMPARATIVE EVALUATIONS: Q2,Q3,Q4,Q5,Q6,Q7;COST; FEASIBILITY STUDIES;FUEL CELLS: Q1,T4;LEAD-ACID BATTERIES: Q1,T2;LOW TEMPERATURE;MAINTENANCE;RADIO EQUIPMENT POWER SUPPLIES: T1;RADIOISOTOPE BATTERIES: Q1,T5;RECOMMENDATIONS; RELIABILITY;THERMOELECTRIC GENERATORS: Q1,T6;WIND TURBINES: Q1,T7;ZINC-AIR BATTERIES: Q1,T3

F-29

ACCESSION NO.	79R0094351
TITLE(MONO)	ASSESSMENT OF INDUSTRIAL APPLICATIONS FOR FUEL CELL COGENERATION SYSTEMS
EDITOR OR COMP	STICKLES, R.P.; ONEILL, J.K.; SMITH, E.M.
CORPORATE AUTH	LITTLE (ARTHUR D.), INC., CAMBRIDGE, MA (USA)
PAGE NO	210
AVAILABILITY	NTIS PC A10/MF A01.
CONTRACT NO	CONTRACT NAS3-20818
DATE	SEP 1978
CATEGORIES	EDB-300504
PRIMARY CAT	EDB-300504
REPORT NO	N--78-32544
ABSTRACT	THE FUEL CELL ENERGY SYSTEMS ARE DESIGNED WITH AND WITHOUT A UTILITY CONNECTION FOR EMERGENCY BACK-UP POWER. SALE OF ELECTRICITY TO THE UTILITY DURING PERIODS OF LOW PLANT DEMAND IS NOT CONSIDERED. FOR EACH OF THE THREE INDUSTRIAL APPLICATIONS, CONCEPTUAL DESIGNS WERE ALSO DEVELOPED FOR CONVENTIONAL UTILITY SYSTEMS RELYING ON PURCHASED ELECTRIC POWER AND FOSSIL-FIRED BOILERS FOR STEAM/HOT WATER. THE CAPITAL INVESTMENT FOR EACH ENERGY SYSTEM IS ESTIMATED. ANNUAL OPERATING COSTS ARE ALSO DETERMINED FOR EACH SYSTEM. THESE COST ESTIMATES ARE CONVERTED TO LEVELIZED ANNUAL COSTS BY APPLYING APPROPRIATE ECONOMIC FACTORS. THE BREAKEVEN ELECTRICITY PRICE THAT WOULD MAKE FUEL CELL SYSTEMS COMPETITIVE WITH THE CONVENTIONAL SYSTEMS IS PLOTTED AS A FUNCTION OF NAPHTHA PRICE. THE SENSITIVITY OF THE BREAKEVEN POINT TO CAPITAL INVESTMENT AND COAL PRICE IS ALSO EVALUATED.
DESCRIPTORS	BREAKEVEN;CHARGES;CO-GENERATION;ECONOMIC ANALYSIS: Q1;ELECTRIC UTILITIES;FUEL CELL POWER PLANTS: T1;HYDROCARBON FUEL CELLS: Q2; INDUSTRIAL PLANTS: T2;INVESTMENT;OPERATING COST

F-30

ACCESSION NO.	79R0094343
TITLE(MONO)	DEVELOPMENT OF ADVANCED FUEL CELL SYSTEM. FINAL REPORT, 25 FEBRUARY--31 DECEMBER 1976
EDITOR OR COMP	GITLOW, B.; MEYER, A.P.; BELL, W.F.; MARTIN, R.E.
CORPORATE AUTH	UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CT (USA)
PAGE NO	74
AVAILABILITY	NTIS PC A04/MF A01.
CONTRACT NO	CONTRACT NAS3-19776
DATE	6 JUN 1978
CATEGORIES	EDB-300502
PRIMARY CAT	EDB-300502
REPORT NO	N--79-12863
ABSTRACT	AN EXPERIMENTAL PROGRAM WAS CONDUCTED CONTINUING THE DEVELOPMENT EFFORT TO IMPROVE THE WEIGHT, LIFE, AND PERFORMANCE CHARACTERISTICS OF HYDROGEN-OXYGEN ALKALINE FUEL CELLS FOR ADVANCED POWER SYSTEMS. THESE ADVANCED TECHNOLOGY CELLS OPERATE WITH PASSIVE WATER REMOVAL WHICH CONTRIBUTES TO A LOWER SYSTEM WEIGHT AND EXTENDED OPERATING LIFE. ENDURANCE EVALUATION OF TWO SINGLE CELLS AND TWO, TWO-CELL PLAQUES WAS CONTINUED. THREE NEW TEST ARTICLES WERE FABRICATED AND TESTED. A SINGLE CELL COMPLETED 7038 HOURS OF ENDURANCE TESTING. THIS CELL INCORPORATED A FYBEX MATRIX, HYBRID-FRAME, PPF ANODE, AND A 90 AU/10 PT CATHODE. THIS CONFIGURATION WAS DEVELOPED TO EXTEND CELL LIFE. TWO CELL PLAQUES WITH DEDICATED FLOW FIELDS AND MANIFOLDS FOR ALL FLUIDS DID NOT EXHIBIT THE CELL-TO-CELL ELECTROLYTE TRANSFER THAT LIMITED THE OPERATING LIFE OF EARLIER MULTICELL PLAQUES.
DESCRIPTORS	HYDROGEN FUEL CELLS: T1;PERFORMANCE;PERFORMANCE TESTING: Q1; SERVICE LIFE: Q1;WEIGHT

F-31

ACCESSION NO.	79C0094340
TITLE(MONO)	SOLID ELECTROLYTE FUEL CELL FOR ELECTRIC UTILITY POWER GENERATION
EDITOR OR COMP	SRINIVASAN, S.; ISAACS, H.S.
CORPORATE AUTH	BROOKHAVEN NATIONAL LAB., UPTON, NY (USA)
SEC REPT NO	CONF-790803--29
PAGE NO	10
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-0016
CONF TITLE	14. INTERSOCIETY ENERGY CONVERSION CONFERENCE
CONF PLACE	BOSTON, MA, USA
CONF DATE	5 AUG 1979

DATE	1979
CATEGORIES	EDB-300501
PRIMARY CAT	EDB-300501
REPORT NO	BNL--26238
ABSTRACT	THE ACCEPTANCE THAT COAL WILL INCREASINGLY BE THE PRIMARY ENERGY SOURCE OF THE FUTURE, PARTICULARLY IN THE USA, EMPHASIZES THE NECESSITY FOR DEVELOPING HIGH TEMPERATURE FUEL CELLS WITH MOLTEN CARBONATES OR SOLID ELECTROLYTES. SOME POTENTIAL ADVANTAGES OF SOLID ELECTROLYTE OVER THE MOLTEN ELECTROLYTE FUEL CELLS ARE: (I) HIGHER PROJECTED EFFICIENCIES BY AT LAST 5% (50% VS 45%); (II) HIGHER ATTAINABLE CURRENT DENSITIES, BY A FACTOR OF THREE, AT CELL POTENTIALS OF ABOUT 0.75 V; (III) NO NEED TO RECYCLE THE CO$SUB 2$ STREAM FROM ANODE TO CATHODE; (IV) NO CELL CORROSION PROBLEMS; AND (V) STABLE ELECTROLYTES. BROWN, BOVERI AND CIE HAVE RUN A SINGLE CELL FOR OVER 40,000 HOURS AND A MULTI-CELL STACK FOR OVER 10,000 HOURS. A WESTINGHOUSE MULTI-CELL STACK (5 CELLS) WAS DESIGNED, FABRICATED AND TESTED FOR OVER 700 HOURS. THE OPERATING CELL CHARACTERISTICS (200 MA CM$SUP -2$ AT 0.7 VOLTS) ARE ENCOURAGING IN RESPECT TO MEETING POWER PLANT PERFORMANCE GOALS. SOLID ELECTROLYTE FUEL CELL POWER PLANTS APPEAR PROMISING FOR LARGE SCALE POWER GENERATION AFTER THE YEAR 2000.
DESCRIPTORS	COAL FUEL CELLS: T2;COAL GASIFICATION;COMPARATIVE EVALUATIONS; CORROSION;CURRENT DENSITY;EFFICIENCY;ELECTROLYTES;FUEL CELL POWER PLANTS: T;HIGH-TEMPERATURE FUEL CELLS: T1;IONIC CONDUCTIVITY;OPERATION;PERFORMANCE: Q1,Q2;REVIEWS;SOLID ELECTROLYTES

F-32

ACCESSION NO.	79C0062921
TITLE	HIGH ENERGY DENSITY MARINE FUEL CELL SYSTEMS
AUTHORS	URBACH, H.B.; WOERNER, J.A.
AUTHOR AFF	DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS, MD
TITLE(MONO)	MARINE PROPULSION
EDITOR OR COMP	SLADKY, J. JR. (ED.)
SEC REPT NO	CONF-761267--P3
PAGE NO	217-229
CONF TITLE	WINTER MEETING OF THE ASME
CONF PLACE	NEW YORK, NY, USA
CONF DATE	5 DEC 1976
PUBL LOC	AMERICAN SOCIETY OF MECHANICAL ENGINEERS, NEW YORK, NY
DATE	1976
CATEGORIES	EDB-300504
PRIMARY CAT	EDB-300504
ABSTRACT	BECAUSE OF THE HIGH EFFICIENCY OF FUEL CELLS THEY ARE UNIQUELY SUITED TO POWERING SMALL SUBMERSIBLES WHERE EXTENDED RANGE OR MISSION TIME IS NEEDED. NEVERTHELESS, FUEL-CELL POWER HAS BEEN USED ONLY TO OPERATE LIGHTING SYSTEMS IN ONE OF COUSTEAU'S DIVING SAUCERS. HOWEVER, A FUEL CELL POWER PLANT DESIGNED FOR SHIP PROPULSIONS PRESENTLY UNDERGOING INSTALLATION IN THE DEEP SUBMERGENCE RESCUE VEHICLE (DSRV). ALTHOUGH THE POWER-WEIGHT RATION OF THE DSRV POWER PLANT IS ATTRACTIVE WHEN COMPARED WITH BATTERIES AND DIESEL ENGINES, IT IS THE ENERGY-WEIGHT RATIO WHICH MOTIVATES FUEL-CELL APPLICATION. EXAMINATION OF THE ENERGY SUBSYSTEM OF THE DSRV VEHICLE SHOWS THAT THE PLANT IS CAPABLE OF PROVIDING ONLY 0.22 KWH/KG OF ENERGY SYSTEM WEIGHT BECAUSE 35 KG OF PRESSURIZED HYDROGEN ARE STORED IN 2180 KG OF PRESSURE VESSEL. ANALYSIS REVEALS THAT FUEL-CELL ENERGY SYSTEMS UTILIZING LIGHT METAL HYDRIDES AND PEROXIDE YIELD SIGNIFICANT INCREASES IN ENERGY-WEIGHT RATIOS AND THEREFORE ENDURANCE. ONE HYDRIDE SYSTEM COMPRISED OF LIH AND H$SUB 2$O$SUB 2$ IS ALMOST NEUTRALLY BUOYANT SO THAT WHEN THE ENERGY PACKAGE IS LOCATED OUTSIDE THE PRESSURE HULL, 0.83 KWH/KG IS YIELDED. A CONCEPTUAL DESIGN OF AN ADVANCED WORK VEHICLE OF 50 METRIC TONS FITTED WITHAN ADVANCED DSRV FUEL CELL AND LIH--H$SUB 2$O$SUB 2$ ENERGY PACKAGE APPEARS TO BE CAPABLE OF A TOP SPEED OF 14 KM/H (8 KNOTS) OR AN UNINTERRUPTED DEEP SUBMERSIBLE OPERATION OF 135 HOURS.
DESCRIPTORS	FUEL CELLS: T,Q1,Q2;HYDRAZINE FUEL CELLS;HYDROGEN FUEL CELLS; HYDROGEN PEROXIDE;LITHIUM HYDRIDES;PERFORMANCE;SHIPS: T1; SPECIFICATIONS;SUBMARINES: T2;USES;WEIGHT

F-33

ACCESSION NO.	79R0062940
TITLE(MONO)	MARKET ASSESSMENT OF FUEL CELL TOTAL ENERGY SYSTEMS SUMMARY REPORT
EDITOR OR COMP	NIXON, W.R.; CHRISTIAN, J.E.; JACKSON, W.L.; PINE, G.D.; HAGLER, M.; SHANKER, R.; KOPPELMAN, L.; GREENSTEIN, D.

CORPORATE AUTH	OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO	117
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-26
DATE	MAR 1979
CATEGORIES	EDB-300504;299003;290200
PRIMARY CAT	EDB-300504
REPORT NO	ORNL/CON--36
ABSTRACT	AN INVESTIGATION OF THE POTENTIAL MARKET PENETRATION OF FUEL CELL TOTAL ENERGY SYSTEMS (FCTES) INTO THE NONINDUSTRIAL, SINGLE BUILDING MARKET IS SUMMARIZED. NINE BUILDING TYPES, TWO TYPES OF CONSTRUCTION, AND THE TEN DEPARTMENT OF ENERGY (DOE) REGIONS WERE USED TO MODEL THE MARKET FOR THE TIME PERIOD 1985--2000. INPUT DATA DEVELOPED FOR THE PENETRATION MODEL INCLUDED SIZE DISTRIBUTIONS OF EACH BUILDING TYPE AND PERFORMANCE AND COST CHARACTERISTICS OF FCTES AND COMPETING CONVENTIONAL SYSTEMS. TWO FUEL CELL SYSTEMS, FUEL CELL - HEAT PUMP AND FUEL CELL - CENTRAL BOILER AND CHILLER, WERE ASSUMED TO COMPETE WITH TWO CONVENTIONAL SYSTEMS, ELECTRIC HEAT PUMP AND CENTRAL CHILLER-BOILER MODELS. TWO FUEL CELL SUPPLY SITUATIONS WERE CONSIDERED: (A) ONE IN WHICH ONLY 40 KW(E) MODULES WERE AVAILABLE, AND (B) ONE IN WHICH A CATALOG OF 25, 40, 100, AND 250 KW(E) MODULES WERE AVAILABLE. DATA CHARACTERIZING THE ECONOMIC CLIMATE, THE INTENDED MARKET, AND SYSTEM COST AND PERFORMANCE WERE USED TO DETERMINE THE PRESENT VALUE OF LIFE-CYCLE COSTS FOR EACH SYSTEM IN EACH MARKET SEGMENT. TWO MARKET MODELS WERE USED TO ESTIMATE FCTES SALES. IN THE FIRST, THE PERFECT MARKET MODEL, FCTES SALES WERE ASSUMED TO OCCUR IN ALL SEGMENTS IN WHICH THAT SYSTEM HAD THE LOWEST PRESENT-VALUED COSTS. IN THE SECOND, A MARKET DIFFUSION MODEL WAS USED TO OBTAIN A MORE PROBABLE (AND LOWER) SALES ESTIMATE THAN THAT OF THE PERFECT MARKET MODEL. RESULTS ARE PRESENTED AS FCTES SALES FOR EACH MARKET SEGMENT BY FCTES MODULE SIZE AND THE EFFECT ON PRIMARY ENERGY USE BY FUEL TYPE.
DESCRIPTORS	BOILERS;BUILDINGS;COMPARATIVE EVALUATIONS;COST;ECONOMIC ANALYSIS;FINANCIAL INCENTIVES;FUEL CELLS: T1,Q2;HEAT PUMPS; LIFE-CYCLE COST;MARKET;MARKETING RESEARCH: Q1;PERFORMANCE;POWER RANGE 10-100 KW;POWER RANGE 100-1000 KW;REGIONAL ANALYSIS;SIZE; TOTAL ENERGY SYSTEMS: T2,Q1;WASTE HEAT UTILIZATION

F-34

ACCESSION NO.	79C0062919
REPORT NO.PAGE	BNL--50756 PP. 90-94
TITLE	DISCUSSION OF POTENTIAL OF HIGH TEMPERATURE SOLID OXIDE FUEL CELL POWERPLANT SYSTEMS
AUTHORS	WARSHAY, M.
AUTHOR AFF	LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO)	PROCEEDINGS OF THE WORKSHOP ON HIGH TEMPERATURE SOLID OXIDE FUEL CELLS
EDITOR OR COMP	ISAACS, H.S.; SRINIVASAN, S.; HARRY, I.L. (EDS.)
SEC REPT NO	CONF-770568--
PAGE NO	90-94
CONF TITLE	WORKSHOP ON HIGH TEMPERATURE SOLID OXIDE FUEL CELLS
CONF PLACE	UPTON, NY, USA
CONF DATE	5 MAY 1977
DATE	1977
CATEGORIES	EDB-300504
PRIMARY CAT	EDB-300504
REPORT NO	BNL--50756
ABSTRACT	FUEL CELL POWERPLANTS WERE ONE OF TEN CLASSES OF ADVANCED ENERGY CONVERSION SYSTEMS STUDIED IN THE ENERGY CONVERSION ALTERNATIVES STUDY (ECAS) UNDERTAKEN BY NASA(1) FOR ERDA AND NSF. THE POWERPLANT SYSTEMS WERE TO OPERATE ON COAL OR COAL-DERIVED FUELS AND WERE PRIMARILY FOR CENTRAL-STATION BASE LOAD POWER GENERATION. THE OBJECTIVE OF ECAS WAS TO PROVIDE AN EVALUATION OF ADVANCED FOSSIL-FIRED CENTRAL-STATION POWERPLANTS UNDER COMMON GROUND RULES AND CONSTRAINTS AND TO A COMPARABLE LEVEL OF DETAIL.
DESCRIPTORS	BOTTOMING CYCLES;COAL FUEL CELLS;COST;ECONOMICS;EFFICIENCY; FEASIBILITY STUDIES: Q1;FUEL CELL POWER PLANTS: T1; HIGH-TEMPERATURE FUEL CELLS;PERFORMANCE;SERVICE LIFE;SOLID ELECTROLYTES;STEAM TURBINES;WASTE HEAT UTILIZATION

F-35 ACCESSION NO. 79R0062900
TITLE(MONO) ASSESSING COMMERCIALIZATION STRATEGY. FUEL CELL CASE STUDY. FINAL REPORT
CORPORATE AUTH CARNEGIE-MELLON INST. OF RESEARCH, ARLINGTON, VA (USA)
PAGE NO 119
AVAILABILITY DEP. NTIS, PC A06/MF A01.
CONTRACT NO CONTRACT EM-78-S-01-4140
DATE 1978
CATEGORIES EDB-300501;299003;290500
PRIMARY CAT EDB-300501
REPORT NO HCP/M4140--01
ABSTRACT THE PROJECT'S OBJECTIVE WAS TO DEVELOP A MODEL OR FRAMEWORK FOR DOE TO USE IN MANAGING RESEARCH AND DEVELOPMENT PROGRAMS TO THE STAGE AT WHICH THEY ARE COMMERCIALIZED BY THE PRIVATE SECTOR, PRINCIPALLY BY USING THE 40 KW FUEL CELL PROGRAM AS A CASE STUDY. A CONCURRENT STUDY OBJECTIVE WAS TO DEVELOP A FRAMEWORK FOR DOE DECISIONS REGARDING THE 40 KW FUEL CELL PROGRAM ITSELF. THE GENERAL MODEL FOR COMMERCIALIZATION ID DISCUSSED; CONCLUSIONS OF THE STUDY ARE PRESENTED; AND THE IMPLICAIONS OF THESE CONCLUSIONS FOR IMMEDIATE ACTION BY DOE ARE DETAILED. IT IS CONCLUDED THAT THE FUEL CELL HAS SUFFICIENTLY ATTRACTIVE CHARACTERISTICS TO MAKE A SIGNIFICANT CONTRIBUTION TO ENERGY POLICY IF COSTS CAN BE BROUGHT DOWN TO A LEVEL COMPETITIVE WITH CONVENTIONAL TECHNOLOGIES. (WHK)
DESCRIPTORS COMMERCIALIZATION: Q1;COST;DEMONSTRATION PROGRAMS;ECONOMICS; FUEL CELL POWER PLANTS: T1;FUEL CELLS;MARKET;PLANNING;US DOE

F-36 ACCESSION NO. 79C0062898
REPORT NO.PAGE BNL--50756 PP. 122-138
TITLE HIGH TEMPERATURE SOLID OXIDE FUEL CELLS: PRESENT STATE AND PROBLEMS OF DEVELOPMENT
AUTHORS ROHR, F.J.
AUTHOR AFF BROWN, BOVERI AND CIE AG, HEIDELBERG, GERMANY
TITLE(MONO) PROCEEDINGS OF THE WORKSHOP ON HIGH TEMPERATURE SOLID OXIDE FUEL CELLS
EDITOR OR COMP ISAACS, H.S.; SRINIVASAN, S.; HARRY, I.L. (EDS.)
SEC REPT NO CONF-770568--
PAGE NO 122-136
CONF TITLE WORKSHOP ON HIGH TEMPERATURE SOLID OXIDE FUEL CELLS
CONF PLACE UPTON, NY, USA
CONF DATE 5 MAY 1977
DATE 1977
CATEGORIES EDB-300501
PRIMARY CAT EDB-300501
REPORT NO BNL--50756
ABSTRACT THE TECHNICAL REALIZABILITY AND ECONOMIC USE OF HIGH TEMPERATURE FUEL CELLS ARE DEPENDENT ON WHETHER IT WILL BE POSSIBLE TO SOLVE ALL PROBLEMS IN VIEW OF TECHNOLOGY AND MATERIAL, ARISING FROM THE HIGH OPERATING TEMPERATURE, AND TO ATTAIN THE EXPECTED POWER DENSITY AND EFFICIENCY DATA FOR A SUFFICIENTLY LONG LIFETIME. EXTENSIVE RESEARCH WORK HAS BEEN DONE IN SOME LABORATORIES TO SOLVE THESE PROBLEMS. ABOVE ALL, EFFORTS HAVE BEEN CONCENTRATED ON THE DEVELOPMENT OF THE SOLID ELECTROLYTE, THE FUEL- AND AIR-ELECTRODE, AS WELL AS ON THE LIFETIME TESTING OF THESE COMPONENTS IN SINGLE CELLS. FURTHERMORE, STUDIES HAVE BEEN MADE CONCERNING THE BASIC PROBLEM OF CONNECTING CELLS IN SERIES BY MEANS OF AN INTERCONNECTION MATERIAL, AND ALSO ON THE DEVELOPMENT OF MODULE CONCEPTS FOR THE CONSTRUCTION OF BATTERIES.
DESCRIPTORS CONNECTORS;CURRENT DENSITY;DESIGN;ELECTRIC CONDUCTIVITY; ELECTRODES;HIGH-TEMPERATURE FUEL CELLS: T1;IONIC CONDUCTIVITY; PERFORMANCE;SERVICE LIFE;SOLID ELECTROLYTES;TECHNOLOGY ASSESSMENT: Q1;ZIRCONIUM OXIDES

F-37 ACCESSION NO. 79R0061596
TITLE(MONO) ADVANCED ELECTRICAL GENERATING TECHNOLOGIES: REPORT ON A FOCUS GROUP DISCUSSION
EDITOR OR COMP MORRILL, W.A.
CORPORATE AUTH MATHEMATICA POLICY RESEARCH, PRINCETON, NJ (USA)
PAGE NO 52
AVAILABILITY DEP. NTIS, PC A04/MF A01.
CONTRACT NO CONTRACT EV-78-C-01-6388

DATE 10 NOV 1978

CATEGORIES EDB-200102;296001;300500;014000;299003

PRIMARY CAT EDB-200102

REPORT NO DOE/TIC—10025

ABSTRACT THIS DISCUSSION REPRESENTS A QUALITATIVE ASSESSMENT OF THE DIMENSIONS OF OPINION CONCERNING THE COMMERCIALIZATION POTENTIAL OF ADVANCED ELECTRIC-GENERATING TECHNOLOGIES. THE GROUP OF POTENTIAL USERS, RESEARCH SPONSORS, AND MANUFACTURERS DISCUSSED THREE DIFFERENT ADVANCED ELECTRICAL GENERATION TECHNOLOGIES—FLUIDIZED-BED COMBUSTION, FUEL CELLS, AND COMBINED CYCLES. THE GROUP INDICATED THAT ALL THREE TECHNOLOGIES SHOWED POTENTIAL FOR COMMERCIAL APPLICATION, AND MADE A STRONG POINT THAT THE CIRCUMSTANCES APPLICABLE IN EACH UTILITY SYSTEM—DEMAND PATTERNS, EXISTING GENERATING PLANTS, FINANCIAL STATUS, ENVIRONMENTAL REQUIREMENTS, ETC.—AS WELL AS PERFORMANCE, COSTS, AND OTHER CRITERIA WOULD DICTATE THE CHOICE. FUEL CELLS MAY BE MORE ATTRACTIVE IN MEETING ONE UTILITY'S NEEDS, WHILE FLUIDIZED-BED COMBUSTION MAY BE MORE ATTRACTIVE TO ANOTHER. THESE TECHNOLOGIES HAVE EMERGED IN RESPONSE TO SPECIFIC UTILITY NEEDS RATHER THAN AS TECHNOLOGY DEVELOPMENT FOR ITS OWN SAKE. THESE TECHNOLOGIES ARE SEEN AS IMPORTANT AS A RESULT OF NUCLEAR SLOWDOWN AND DIFFICULTY IN FINDING ADEQUATE SUPPLIES OF COMPLIANCE COAL. THE NEED FOR DEMONSTRATION PROGRAMS WAS STRESSED TO PROVIDE FIRM EVIDENCE OF COST AND RELIABILITY PRIOR TO GENERAL USE BY UTILITIES IN WHICH GOVERNMENT FINANCING WOULD NEED TO PLAY A PART. CONSIDERABLE DISCUSSION CENTERED ON HOW THE 3 TECHNOLOGIES WOULD FIT INTO THE ENERGY-SUPPLY PICTURE AND WHAT CONTRIBUTION THEY MIGHT MAKE IN TOTAL ENERGY SUPPLY.

DESCRIPTORS COMBINED CYCLES: T3,04;COMMERCIALIZATION;DEMAND FACTORS; DEMONSTRATION PROGRAMS;ELECTRIC UTILITIES;ENVIRONMENTAL EFFECTS; EVALUATION: Q1,Q2,Q3;FEASIBILITY STUDIES;FLUIDIZED-BED COMBUSTION: T1,Q4;FUEL CELLS: T2,Q4;NUCLEAR POWER PLANTS; PLANNING;POWER GENERATION: T4;RELIABILITY;RESOURCE POTENTIAL

F-38 ACCESSION NO. 79R0055385

TITLE(MONO) ALTERNATIVE ENERGY SOURCES FOR FEDERAL AVIATION ADMINISTRATION FACILITIES. FINAL REPORT, MAY 1976--JANUARY 1976

EDITOR OR COMP HINKLEY, L.G.; APOSTOLAKIS, G.C.; BONELLO, A.H.

CORPORATE AUTH NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, NJ (USA)

PAGE NO 121

AVAILABILITY NTIS PC A06/MF A01.

DATE AUG 1976

CATEGORIES EDB-300000;300500;300300;300400;140501;170000

PRIMARY CAT EDB-300000

REPORT NO AD-A—058681

ABSTRACT A LITERATURE AND INDUSTRY/GOVERNMENT SEARCH WAS MADE ON ALTERNATIVE ENERGY SOURCES. THIS ENERGY INVESTIGATION EFFORT CONCENTRATED ON PHOTOVOLTAICS, WIND, FUEL CELLS AND THERMOELECTRIC/THERMIONIC GENERATORS THAT WOULD PRODUCE ELECTRICAL ENERGY AND APPEARED FEASIBLE FOR USE AT FEDERAL AVIATION ADMINISTRATION (FAA) FACILITIES. AS AN AID TO IDENTIFY POTENTIAL FAA FACILITIES WHERE IT MIGHT BE FEASIBLE TO USE AN ALTERNATIVE ENERGY SYSTEM, TWO QUESTIONNAIRES WERE DEVELOPED AND DISTRIBUTED WITH THE INTENT THAT A FURTHER IN-DEPTH INVESTIGATION INTO A FEW SELECTED SITES WOULD FOLLOW. DATA FROM THESE QUESTIONNAIRES WERE RECEIVED AND TABULATED. AS A RESULT OF THIS INVESTIGATION, IT WAS RECOMMENDED THAT THE FAA PROCEED TO ESTABLISH ALTERNATIVE ENERGY DEMONSTRATION SITES IN ORDER TO GAIN EXPERIENCE IN THE DESIGN, IMPLEMENTATION, AND OPERATION OF SUCH SYSTEMS. IN ADDITION IT WAS RECOMMENDED THAT DUE TO THE CONSTANTLY CHANGING AND FAST ADVANCING NATURE OF ENERGY CONVERSION SYSTEMS, THE FAA SHOULD EXPEND SOME LEVEL OF EFFORT IN CONTINUING THE LITERATURE/INDUSTRY/GOVERNMENT SEARCH INITIATED UNDER THIS PROJECT IN ORDER TO REMAIN CURRENT ON THE SUBJECT. ALSO THE FAA SHOULD ESTABLISH A CENTRALIZED DATA COLLECTION AND TABULATION POINT FOR ENERGY REQUIREMENTS/CONSUMPTION/COST DATA ON A FACILITY BASIS.

DESCRIPTORS ENERGY CONVERSION: T1;ENERGY SOURCES: Q1;FUEL CELLS: T; PHOTOVOLTAIC CONVERSION: T;REVIEWS;THERMIONIC CONVERTERS: T; THERMOELECTRIC GENERATORS: T;WIND POWER: T

F-39 ACCESSION NO. 79B0049213
TITLE (MONO) OPERATING CHARACTERISTICS OF AN ECONOMICAL HIGH TEMPERATURE FUEL CELL
EDITOR OR COMP BAKER, B.S.; MARIANOWSKI, L.G.
PAGE NO 9
AVAILABILITY AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 345 EAST 47TH ST., NEW YORK, NY 10017.
PUBL LOC AMERICAN SOCIETY OF MECHANICAL ENGINEERS, NEW YORK, NY
DATE ND*
CATEGORIES EDB-300500
PRIMARY CAT EDB-300500
AUGMENTATION MOLTEN SALT ELECTROLYTES
ABSTRACT RESEARCH AT THE INSTITUTE OF GAS TECHNOLOGY ON HIGH-TEMPERATURE FUEL CELLS USING MOLTEN SALT ELECTROLYTES AND HYDROCARBON FUELS OPERATING AT 900 TO 1300$SUP 0$F IS DISCUSSED. THE OPERATION AND PERFORMANCE CHARACTERISTICS (VOLTAGE--CURRENT CHARACTERISTICS) ARE DISCUSSED, AND THE TEMPERATURE DISTRIBUTION WITHIN A CELL IS SHOWN. ALSO, THE EFFICIENCY AND ECONOMICS OF MOLTEN SALT FUEL CELLS ARE CONSIDERED. (WHK)
DESCRIPTORS DIAGRAMS;ECONOMICS;EFFICIENCY;ELECTRICAL PROPERTIES; ELECTROLYTES;HEAT TRANSFER;HIGH-TEMPERATURE FUEL CELLS: H1; HYDROCARBON FUEL CELLS: H2;MOLTEN SALTS;OPERATION;PERFORMANCE; RESEARCH PROGRAMS;REVIEWS: Q1,Q2

F-40 NONE

F-41 ACCESSION NO. 79C0042464
TITLE BRUNO BREYER MEMORIAL LECTURE ON THE DEVELOPMENT AND PRACTICAL APPLICATION OF FUEL CELLS
AUTHORS BACON, F.T.
TITLE (MONO) TRENDS IN ELECTROCHEMISTRY
EDITOR OR COMP BOCKRIS, J.O.; RAND, D.A.J.; WELCH, B.J. (EDS.)
SEC REPT NO CONF-760271--
PAGE NO 27-50
CONF TITLE 4. ELECTROCHEMICAL CONFERENCE
CONF PLACE BEDFORD PARK, AUSTRALIA
CONF DATE 16 FEB 1976
PUBL LOC PLENUM PRESS, NEW YORK, NY
DATE 1977
CATEGORIES EDB-300500
PRIMARY CAT EDB-300500
ABSTRACT THE STATE-OF-THE-ART OF FUEL CELL TECHNOLOGY AND APPLICATIONS IN SPACE AND OTHER SPECIAL APPLICATIONS IS GIVEN. PROBABLE MAIN REASONS FOR DROP IN CELL PERFORMANCE WITH TIME, STORAGE OF ELECTRICAL ENERGY, AND PROPOSALS FOR FUTURE WORK ON FUEL CELLS ARE DISCUSSED. 42 REFERENCES. (WHK)
DESCRIPTORS FORECASTING;FUEL CELLS: T1;REVIEWS;TECHNOLOGY ASSESSMENT: Q1; TECHNOLOGY UTILIZATION;USES

F-42

ACCESSION NO.	79C0036973
TITLE(MONO)	HYDROGEN/HALOGEN ENERGY STORAGE SYSTEM
EDITOR OR COMP	SPAZIANTE, P.M.; SIOLI, G.C.; TROTTA, R.; PEREGO, A.; MCBREEN, J.
CORPORATE AUTH	ORONZIO DE NORA IMPIANTI ELETTROCHIMICI S.P.A., MILANO (ITALY); BROOKHAVEN NATIONAL LAB., UPTON, NY (USA)
SEC REPT NO	CONF-761142--3
PAGE NO	14
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-0016
CONF TITLE	CHEMICAL HYDROGEN ENERGY SYSTEMS CONTRACTS REVIEW
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	28 NOV 1976
DATE	1976
CATEGORIES	EDB-300501;250800
PRIMARY CAT	EDB-300501
REPORT NO	BNL--25212
ABSTRACT	THE HYDROGEN/CHLORINE ENERGY STORAGE SYSTEM HAS BEEN CONSIDERED AT BNL FOR LARGE SCALE ENERGY STORAGE. IN FY1978 WORK INCLUDED AN ASSESSMENT OF SYSTEM SAFETY AND COST, INVESTIGATIONS OF CELL PERFORMANCE UNDER CONDITIONS ELEVATED PRESSURE AND TEMPERATURE, DETERMINATION OF THE TRANSPORT PROPERTIES OF NAFION MEMBRANES AND ELECTROCHEMICAL ENGINEERING STUDIES. RESULTS ARE SUMMARIZED.
DESCRIPTORS	CHLORINE;COST: Q2,Q3;EFFICIENCY;ENERGY STORAGE SYSTEMS: T1;FUEL CELL POWER PLANTS: T2;HYDROGEN FUEL CELLS: T3,Q1;HYDROGEN STORAGE;LAND USE;PERFORMANCE;REGENERATIVE FUEL CELLS;SAFETY: Q2,Q3

F-43

ACCESSION NO.	79C0036971
TITLE	FUEL CELLS AND THEIR FUELS IN THE FUTURE
AUTHORS	WILLIAMS, K.R.
AUTHOR AFF	SHELL INTERNATIONAL PETROLEUM CO. LTD., LONDON, ENG.
TITLE(MONO)	POWER PLANTS AND FUTURE FUELS
SEC REPT NO	CONF-750153--
PAGE NO	69-74
CONF TITLE	CONFERENCE ON POWER PLANTS AND FUTURE FUELS
CONF PLACE	LONDON, UK
CONF DATE	21 JAN 1975
PUBL LOC	INSTITUTION OF MECHANICAL ENGINEERS, LONDON, ENGLAND
DATE	1976
CATEGORIES	EDB-300500;300504;330400
PRIMARY CAT	EDB-300500
ABSTRACT	THE UNDERLYING PRINCIPLES OF FUEL CELLS ARE OUTLINED AND IT IS NOTED THAT ONLY LOW TEMPERATURE FUEL CELLS HAVE BEEN DEVELOPED TO THE STAGE WHERE POWER SYSTEMS HAVE BEEN BUILT. OF THESE CELLS, THE HYDROGEN-AIR TYPES ARE THE ONLY ONES WHICH HAVE BEEN BROUGHT TO THE STAGE WHERE COSTS ARE APPROACHING A LEVEL WHERE THEY COULD BE CONSIDERED FOR PRACTICAL USE. THE FUEL HYDROGEN MAY BE GENERATED FROM METHANOL, LIGHT HYDROCARBONS OF LOW SULFUR CONTENT OR AMMONIA. STORAGE OF HYDROGEN IN THE FORM OF METALLIC HYDRIDES IS RECEIVING ATTENTION. ULTIMATELY FUEL CELLS WHICH USE METHANOL DIRECTLY SEEM TO BE THE TYPE WITH MOST WIDESPREAD APPLICABILITY.
DESCRIPTORS	ALCOHOL FUEL CELLS;ECONOMICS;FUEL CELLS: T1,Q2;FUELS: Q1;HYBRID ELECTRIC-POWERED VEHICLES: T2;HYDRAZINE FUEL CELLS;HYDROGEN FUEL CELLS;HYDROGEN GENERATORS;HYDROGEN PRODUCTION;HYDROGEN STORAGE;METHANOL;OPERATION;REVIEWS: Q1

F-44

ACCESSION NO.	79J0036845
TITLE	ASSESSMENT OF FUELS FOR POWER GENERATION BY ELECTRIC UTILITY FUEL CELLS

AUTHOR AFF	ARTHUR D. LITTLE, INC. CAMBRIDGE, MASS
PUB DESC	EPRI REP., EM, V. 1, NO. 695, PP. 1-315
DATE	MAR 1978
CATEGORIES	EDB-294000;200108;200106;300504;015000;020700
PRIMARY CAT	EDB-294000
ABSTRACT	TWO VOLUMES OF A REPORT ON A RESEARCH PROGRAM WHICH WAS CARRIED OUT TO ASSESS THE TECHNICAL AND ECONOMIC FEASIBILITY OF ALTERNATE FUEL OPTIONS FOR DISPERSED AND BASELOAD UTILITY-SCALE FUEL CELL POWER PLANTS ARE INCLUDED. THE ASSESSMENT COVERS COAL-DERIVED AND PETROLEUM-DERIVED FUELS, AND NEAR-TERM AND ADVANCED FUEL CONVERSION AND FUEL CELL TECHNOLOGIES. A FORECAST OF INTERNATIONAL CRUDE OIL PRICES OVER THE PERIOD OF 1980 TO 2000 IS DEVELOPED. THREE OIL-BASED DISPERSED FUEL CELL AND SIX COAL-BASED CENTRAL FUEL CELL POWER PLANTS WERE CHARACTERIZED IN TERMS OF PROCESS CONDITIONS, ENERGETICS, AND COST. THESE HARDWARE ELEMENTS WERE COMBINED WITH THE FUEL PRICE PROJECTIONS INTO A RELATIVE COST COMPARISON INDEX. COMPARISON INDICES ARE PRESENTED FOR BOTH BASELOAD AND DISPERSED FUEL CELL APPLICATIONS BY FORECAST YEAR, GEOGRAPHICAL LOCATION, TECHNOLOGY, AND FUEL OPTION. IT IS SHOWN THAT THE PROJECTED PRICES AND AVAILABILITY OF NAPHTHA FOR FIRST GENERATION DISPERSED FUEL CELLS ARE FAVORABLE BASED ON THE FORECASTED INCREMENTAL DEMAND PROFILE FOR PETROLEUM PRODUCTS. HOWEVER, DEMAND WITH HIGH FUEL CELL PENETRATION COULD CAUSE A CONFLICT WITH PETROCHEMICAL USERS. THEREFORE ADVANCED FUEL CELL SYSTEMS SHOULD HAVE THE CAPABILITY TO USE LOW SULFUR DISTILLATE OIL. MOLTEN CARBONATE FUEL CELLS INTEGRATED WITH NEAR TERM COAL GASIFIERS SHOW PROMISE FOR ECONOMICAL AND EFFICIENT BASELOAD POWER GENRATION. SYNTHETIC LIQUID FUEL DERIVED FROM COAL IS NOT COMPETITIVE WITH PETROLEUM-DERIVED FUELS IN THE 1960-1990 TIME FRAME. 23 REFS.
DESCRIPTORS	AVAILABILITY;CHARGES;COAL;COAL FUEL CELLS;COAL GAS;COMPARATIVE EVALUATIONS;COST;ECONOMICS;FORECASTING;FOSSIL FUELS: Q1;FUEL CELL POWER PLANTS: T1;HIGH-TEMPERATURE FUEL CELLS;HYDROCARBON FUEL CELLS;NAPHTHA;PETROLEUM;POWER GENERATION

F-45	ACCESSION NO.	79C0036720
REPORT NO.PAGE	EPRI-EM--718-W PP. 331-335
TITLE	DEPARTMENT OF ENERGY FUEL-CELL PROGRAM
AUTHORS	VOELKER, G.E.
AUTHOR AFF	DEPT. OF ENERGY, WASHINGTON, DC
TITLE (MONO)	WORKSHOP PROCEEDINGS: DUAL ENERGY USE SYSTEMS
EDITOR OR COMP	DOUGHERTY, D.A. (ED.)
SEC REPT NO	CONF-7709152--
PAGE NO	331-335
CONF TITLE	WORKSHOP ON DUAL ENERGY USE SYSTEMS
CONF PLACE	YARMOUTH, ME, USA
CONF DATE	19 SEP 1977
DATE	MAY 1978
CATEGORIES	EDB-290800;300504;320603;296001
PRIMARY CAT	EDB-290800
REPORT NO	EPRI-EM--718-W
ABSTRACT	THE USE OF FUEL CELLS FOR ELECTRIC-UTILITY SYSTEMS OR AS PART OF AN ON-SITE TOTAL ENERGY SYSTEM OFFERS SEVERAL ADVANTAGES: IT IS A NONPOLLUTING AND WATER-CONSERVATIVE TECHNOLOGY WITH A RELATIVELY HIGH EFFICIENCY. IT CAN BE CONSTRUCTED IN MODULAR UNITS AND CAN BE LOCATED CLOSE TO THE LOAD, THEREBY REDUCING TRANSMISSION LOSSES AND COSTS. THIS PAPER PRESENTS A STATUS REPORT ON THE DOE FUEL-CELL PROGRAM AND HIGHLIGHTS OF SOME NEW PROGRAM DIRECTIONS.
DESCRIPTORS	ECONOMICS;EFFICIENCY;ELECTRIC UTILITIES: T2;ENVIRONMENTAL EFFECTS;FEASIBILITY STUDIES;FUEL CELLS: T3,Q1,Q2;PLANNING;POWER TRANSMISSION LINES;RESEARCH PROGRAMS: Q1,Q3;RESOURCE CONSERVATION;TECHNOLOGY ASSESSMENT;TOTAL ENERGY SYSTEMS: T1;US DOE;USES;WATER RESOURCES

F-46	ACCESSION NO.	79C0036719
REPORT NO.PAGE	EPRI-EM--718-W PP. 323-329
TITLE	DEUS FUEL CELLS
AUTHORS	FICKETT, A.P.
AUTHOR AFF	ELECTRIC POWER RESEARCH INST., PALTO ALTO, CA
TITLE (MONO)	WORKSHOP PROCEEDINGS: DUAL ENERGY USE SYSTEMS

EDITOR OR COMP	DOUGHERTY, D.A. (ED.)
SEC REPT NO	CONF-7709152--
PAGE NO	323-329
CONF TITLE	WORKSHOP ON DUAL ENERGY USE SYSTEMS
CONF PLACE	YARMOUTH, ME, USA
CONF DATE	19 SEP 1977
DATE	MAY 1978
CATEGORIES	EDB-290800;296001;300500
PRIMARY CAT	EDB-290800
REPORT NO	EPRI-EM--718-W
ABSTRACT	THE STATE OF THE ART OF THE FUEL CELL, THE BENEFITS OF FUEL CELLS TO UTILITY SYSTEMS, AS WELL AS THE POTENTIAL USE OF FUEL CELLS IN DUAL ENERGY USE SYSTEMS ARE EXPLAINED. THE EPRI FUEL CELL PROGRAM IS DEVELOPING TWO GENERATIONS OF FUEL CELLS. THE FIRST GENERATION OF CELLS WILL OPERATE ON NAPHTHA, HOPEFULLY HAVE A CAPITAL COST OF $250/KW, AND HAVE AN EFFICIENCY OF ABOUT 36% (A HEAT RATE OF 9300 BTU/KWH). THE ADVANCED GENERATION FUEL CELL (AVAILABLE IN ABOUT 5 TO 10 YEARS) WILL INITIALLY OPERATE ON LIQUIDS, AT $200/KW, AND LATER ON COAL INTEGRATED WITH A COAL GASIFIER AT $600/KW. A HEAT RATE OF ABOUT 7500 BTU/KWH, 45% EFFICIENCY, WILL BE ATTAINED EITHER WITH COAL OR LIQUID.
DESCRIPTORS	ACID ELECTROLYTE FUEL CELLS;COAL FUEL CELLS;DEUS: T1;ECONOMICS: Q2;EFFICIENCY: Q2;ELECTRIC UTILITIES;ENVIRONMENTAL EFFECTS;EPRI; FUEL CELLS: T2;NAPHTHA;OPERATION: Q1;PLANNING;RESEARCH PROGRAMS: Q2;SULFURIC ACID;USES

F-47

ACCESSION NO.	79C0031065
TITLE	THIN FILM HIGH TEMPERATURE SOLID ELECTROLYTE FUEL CELLS
AUTHORS	ISENBERG, A.O.
AUTHOR AFF	WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA
TITLE(MONO)	PROCEEDINGS OF THE SYMPOSIUM ON ELECTRODE MATERIALS AND PROCESSES FOR ENERGY CONVERSION AND STORAGE
EDITOR OR COMP	MCINTYRE, J.D.E.; SRINIVASAN, S.; WILL, F.G. (EDS.)
SEC REPT NO	CONF-770531--
PAGE NO	682-691
CONF TITLE	MEETING OF THE ELECTROCHEMICAL SOCIETY
CONF PLACE	PHILADELPHIA, PA, USA
CONF DATE	8 MAY 1977
PUBL LOC	ELECTROCHEMICAL SOCIETY, INC., PRINCETON, NJ
DATE	1977
CATEGORIES	EDB-300502;300501
PRIMARY CAT	EDB-300502
ABSTRACT	HIGH TEMPERATURE SOLID ELECTROLYTE FUEL CELLS WHICH ARE FABRICATED WITHOUT THE USE OF NOBLE METALS, CAN OPERATE AT A CURRENT DENSITY OF OVER 500 MA/CM$SUP 2$ WHEN ELECTRICALLY INTERCONNECTED IN STACKS. THE COMPLEX STRUCTURE OF INTERCONNECTED FUEL CELLS DEMANDS MATCHING MATERIALS PROPERTIES OF FIVE STACK COMPONENTS WITH RESPECT TO THERMAL EXPANSION, NON-REACTIVITY AND THERMODYNAMIC STABILITY. PERFORMANCE OF INTERCONNECTED CELLS AND STATE-OF-THE-ART PREPARATION TECHNIQUES ARE REVIEWED. THE LIFE OF CELL STACKS IS LIMITED MAINLY DUE TO MECHANICAL FAILURE OF THE CELL INTERCONNECTION. NEW INTERCONNECTION MATERIALS AND BETTER FILM DEPOSITION PROCESSES ARE NEEDED IN ORDER TO INCREASE STACK LIFE.
DESCRIPTORS	CONNECTORS;FABRICATION: Q1;FAILURES;FILMS;HIGH-TEMPERATURE FUEL CELLS: T1;PERFORMANCE: Q1;SERVICE LIFE

F-48

ACCESSION NO.	79U0031064
TITLE	FUEL CELL BATTERY IN CONTINUOUS OPERATION
PUB DESC	ELEKTRIKER, V. 16, NO. 12, P. 332
DATE	DEC 1977
LANGUAGE	IN GERMAN
CATEGORIES	EDB-300502
PRIMARY CAT	EDB-300502
ABSTRACT	A REPORT IS GIVEN ON A CONTINUOUSLY OPERATING AND DISTURBANCE-FREE FUEL CELL WHICH HAS BEEN IN OPERATION FOR 10 YEARS. 1967/68 THE CELL WAS PUT INTO USE FOR 1 YEAR'S TESTING AS CURRENT SUPPLY OF A TELEVISION TRANSDUCER AND HAS BEEN WORKING SINCE THEN IN THE SIEMENS RESEARCH CENTRE AG IN ERLANGEN.
DESCRIPTORS	HYDROGEN FUEL CELLS: T1;OPERATION;PERFORMANCE TESTING;POWER RANGE 10-100 W;SERVICE LIFE: Q1

F-49
ACCESSION NO. 79J0020075
TITLE LIQUID FUEL CELL WITH LONG LIFE
AUTHORS YANAGIHARA, N.; MANABE, H.; IWAKI, T.
AUTHOR AFF MATSUSHITA ELECTR. IND. CO., CENT. RES. LAB., OSAKA, JAPAN
PUB DESC NATL. TECH. REP. (MATSUSHITA ELECTR. IND. CO., OSAKA), V. 24, NO. 2, PP. 370-378
DATE APR 1978
LANGUAGE IN JAPANESE WITH ENGLISH ABSTRACT
CATEGORIES EDB-300501;300502
PRIMARY CAT EDB-300501
ABSTRACT A HYDRAZINE FUEL CELL POWER SYSTEM WITH EXTENDED LIFE HAS BEEN DEVELOPED. THE SYSTEM CAN BE OPERATED WITH LITTLE MAINTENANCE AND CARE. TO OBTAIN LONG SYSTEM LIFE, THE MAIN EFFORT WAS CENTERED ON OBTAINING A LONG-LIFE AIR ELECTRODE, PREVIOUSLY CONSIDERED DIFFICULT TO FABRICATE. FURTHER, EFFORTS WERE MADE TO IMPROVE RELIABILITY OF THE CELL ELEMENTS (FUEL ELECTRODE, ETC.), THE DRIVING PUMP ELECTROLYTE, THE AUTOMATIC VOLTAGE REGULATOR, AND OTHER ASSOCIATED DEVICES. THE SYSTEM IS ALSO USEFUL FOR CONTINUOUS SERVICE FOR MORE THAN 5 OR 6 YEARS BY SUPPLYING FUEL AT 0.5 YEAR INTERVALS.
DESCRIPTORS DESIGN: Q1;HYDRAZINE FUEL CELLS: T1;PERFORMANCE TESTING: Q1; PUMPS;RELIABILITY;SERVICE LIFE;TEMPERATURE DEPENDENCE;VOLTAGE

F-50
ACCESSION NO. 79X0008503
TITLE(MONO) MOLTEN CARBONATE FUEL CELL PROGRAM. PROGRESS REPORT, APRIL 1--JUNE 30, 1978
EDITOR OR COMP BRAUNSTEIN, J.; BRONSTEIN, H.R.; CANTOR, S.; PADOVA, J.I.
CORPORATE AUTH OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO 25
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT W-7405-ENG-26
DATE SEP 1978
CATEGORIES EDB-300505
PRIMARY CAT EDB-300505
REPORT NO ORNL/TM--6168/V4
ABSTRACT PROGRESS WAS MADE IN THE MEASUREMENT AND INTERPRETATION OF EMF RELAXATIONS FOLLOWING ELECTROLYSIS OF MOLTEN CARBONATE FUEL CELL TILES. AN EXTENSIVE SERIES OF MEASUREMENTS WAS CARRIED OUT AT 610$SUP 0$C AT CURRENT DENSITIES FROM 29 TO 285 MA/CM$SUP 2$ AND FOR ELECTROLYSIS TIMES OF FROM FIVE MINUTES TO TWO HOURS. THE OBSERVED DECAY OF EMF SHOWS RELAXATION ON THREE TIME SCALES: AN INITIAL RAPID DECAY ON THE TIME SCALE OF DOUBLE LAYER RELAXATION, FOLLOWED BY A DECAY OF THE ORDER OF 10 MINUTES TO AN HOUR, CHARACTERISTIC OF LIQUID STATE DIFFUSION, AND FINALLY A VERY SLOW DECAY (HOURS TO DAYS) WHICH MAY BE RELATED TO SOLID STATE EFFECTS IN THE ELECTRODES. THE MASS TRANSPORT MODEL PROVIDES A SATISFACTORY REPRESENTATION OF THE INTERMEDIATE RELAXATION. COMPUTATION OF THE COMPOSITION DEPENDENCE OF THE ACTIVITY COEFFICIENTS IN LI$SUB 2$CO$SUB 3$-K$SUB 2$CO$SUB 3$ WAS INITIATED USING THE PHASE DIAGRAM, THE HEATS OF MIXING AND A NEW METHOD FOR OBTAINING THE DERIVATIVE OF THE ACTIVITY COEFFICIENTS WITHOUT THE NEED FOR EXTRAPOLATION AND EVALUATION OF UNNECESSARY INTEGRATION CONSTANTS. THIS DERIVATIVE IS NEEDED IN THE INTERPRETATION OF BOTH THE FREE ELECTROLYTE TRANSFERENCE CELL MEASUREMENTS AND THE EMF RELAXATION MEASUREMENTS TO DETERMINE RELATIVE MOBILITIES OF LITHIUM AND POTASSIUM. SLOW PENETRATION OF LI$SUP +$ INTO MASSIVE SAMPLES OF NIO INDICATED THE NEED FOR THINNER SAMPLES IN STUDIES OF LITHIATION OF NIO UNDER FUEL CELL CONDITIONS AND FOR THE PREPARATION OF LITHIATED NIO ELECTRODES OF KNOWN AREA. A SERIES OF EQUILIBRATIONS IN LI$SUB 2$CO$SUB 3$-K$SUB 2$CO$SUB 3$ UNDER CO$SUB 2$-O$SUB 2$ ATMOSPHERES IS BEING CARRIED OUT WITH SINGLE CRYSTAL WAFERS GROUND AND POLISHED TO A THICKNESS OF 0.01 CM.
DESCRIPTORS ALUMINATES;CARBONATES;ELECTRODES;ELECTROLYSIS;ELECTROLYTES; ELECTROMOTIVE FORCE;HIGH-TEMPERATURE FUEL CELLS: T1;LITHIUM; LITHIUM CARBONATES;LITHIUM COMPOUNDS;MASS TRANSFER: Q1;MOLTEN SALTS;POTASSIUM;POTASSIUM CARBONATES;RESEARCH PROGRAMS;SERVICE LIFE

F-51
ACCESSION NO. 79R0002541
TITLE(MONO) THYRISTOR VOLTAGE SAFETY FACTOR. FINAL REPORT
EDITOR OR COMP MUNGENAST, J.; KIRK, D.
CORPORATE AUTH POWER SEMICONDUCTORS, INC., DEVON, CT (USA)
PAGE NO 96
AVAILABILITY DEP. NTIS, PC A05/MF A01.
DATE JUL 1978
CATEGORIES EDB-300503;250903
PRIMARY CAT EDB-300503
REPORT NO EPRI-EM--825
ABSTRACT THIS PROJECT HAS INVESTIGATED THE THEORETICAL AND EXPERIMENTAL BASES FOR REDUCING THE DERATING FACTOR APPLIED TO THYRISTORS USED IN SOLID-STATE CONVERTER DESIGNS. THIS FACTOR, KNOWN AS THE VOLTAGE SAFETY FACTOR (VSF), IS USED AS A MARGIN OF SAFETY TO PROTECT THYRISTORS FROM VOLTAGE TRANSIENTS EXPERIENCED IN APPLICATIONS. FOR FORCE-COMMUTATED (OR SELF-COMMUTATED) CONVERTER DESIGNS, A VSF IN THE RANGE OF 1.4 TO 1.8 MUST BE APPLIED TO RESULT IN AN ECONOMIC UNIT FOR UTILITY APPLICATION WITH BATTERIES AND FUEL CELLS. THE WORK REPORTED SHOWS THAT THESE LOW MARGINS CAN BE USED IN SUCCESSFUL DESIGNS, AND DEFINES AND EXAMINES THE VSF COMPONENTS AND THEIR DEPENDENCE ON CIRCUITRY AND THYRISTOR CHARACTERISTICS.

DESCRIPTORS BREAKDOWN;DESIGN;ELECTRIC BATTERIES: T4;ELECTRONIC CIRCUITS; EQUIPMENT PROTECTION DEVICES: Q1,Q2;FAILURES;FUEL CELLS: T3; INVERTERS: T2,Q3,Q4;LEAKAGE CURRENT;OVERVOLTAGE;PERFORMANCE; PERFORMANCE TESTING;RELIABILITY;SAFETY;SURGES;THYRISTORS: T1; TRANSIENTS

F-52

ACCESSION NO. 79C0002540
TITLE(MONO) ANALYSIS OF PERFORMANCE CAPABILITIES OF REDOX-FLOW STORAGE BATTERIES
EDITOR OR COMP ROY, A.S.; KAPLAN, S.I.
CORPORATE AUTH OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO 5
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT W-7405-ENG-26
CONF TITLE MEETING OF THE AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY
CONF PLACE DENVER, CO, USA
CONF DATE 28 AUG 1978
DATE 1978
CATEGORIES EDB-300501;250800
PRIMARY CAT EDB-300501
REPORT NO CONF-780808--20
ABSTRACT MAJOR PHYSICAL PERFORMANCE PARAMETERS AND ECONOMIC FACTORS OF A GENERALIZED REDOX-FLOW STORAGE BATTERY SYSTEM ARE ANALYZED. THE SYSTEM IS DIVIDED INTO POWER-RELATED AND ENERGY-RELATED SUBSYSTEMS. THE ECONOMIC FACTORS INCLUDE PLANT CAPITAL (AND OTHER) COSTS, ELECTRICAL ENERGY LOST BY THE STORAGE-CYCLE INEFFICIENCY, AND A PENALTY TERM FOR FAILURES. RELATIONSHIPS ARE FORMULATED FOR THE OVERALL SYSTEM EFFICIENCY AND SYSTEM PERFORMANCE PARAMETERS (VOLTAGES, CURRENT DENSITY, STATE-OF-CHARGE OF THE STORAGE LIQUID, AND PARASITIC LOSSES). EQUATIONS FOR SIZING AND COSTING OF THE BATTERY AND THE STORAGE TANK SUBSYSTEMS ARE GIVEN. DIRECTIONS FOR NEEDED RESEARCH ARE INDICATED.
DESCRIPTORS COST;ECONOMICS: Q1;EFFICIENCY;ENERGY STORAGE SYSTEMS: T2;IRON IONS;MATERIALS;PERFORMANCE;REDOX FUEL CELLS: T1,Q2;SIZE

F-53

ACCESSION NO. 79C0002538
REPORT NO,PAGE CONF-771203 PP. 187-189
TITLE ENVIRONMENTAL ASSESSMENT OF RESIDENTIAL ENERGY SUPPLY SYSTEMS THAT USE FUEL CELLS
AUTHORS STEELE, R.V.); JOHNSON, G.L.; CIPRIOS, G.
AUTHOR AFF SRI INTERNATIONAL, MENLO PARK, C
TITLE(MONO) MIAMI INTERNATIONAL CONFERENCE ON ALTERNATIVE ENERGY SOURCES
EDITOR OR COMP VEZIROGLU, T.N. (ED.)
PAGE NO 187-189
CONF TITLE ALTERNATIVE ENERGY SOURCES SYMPOSIUM
CONF PLACE MIAMI BEACH, FL, USA
CONF DATE 5 DEC 1977
DATE 1977
CATEGORIES EDB-300500
PRIMARY CAT EDB-300500
REPORT NO CONF-771203--
ABSTRACT NONE
DESCRIPTORS COAL;COAL LIQUEFACTION;COST;EFFICIENCY;ENVIRONMENTAL IMPACTS: Q1;EVALUATION;FOSSIL-FUEL POWER PLANTS;FUEL CELL POWER PLANTS: T1,Q2;FUEL CELLS;HYGAS PROCESS;RESIDENTIAL BUILDINGS: T2; SYSTEMS ANALYSIS

F-54

ACCESSION NO. 78X0127962
TITLE(MONO) COMPARATIVE STUDY AND EVALUATION OF ADVANCED-CYCLE SYSTEMS. FINAL REPORT
EDITOR OR COMP POMEROY, B.D.; FLECK, J.J.; MARSH, W.D.; BROWN, D.H.; SHAH, R.P.
CORPORATE AUTH GENERAL ELECTRIC CO., SCHENECTADY, NY (USA)
PAGE NO 231
AVAILABILITY DEP. NTIS, PC A11/MF A01.
DATE FEB 1976
CATEGORIES EDB-296001;200102;300101;300401;300501;210500;210300
PRIMARY CAT EDB-296001
REPORT NO EPRI-AF--664(VOL.2)(PT.2)
ABSTRACT APPENDICES D THROUGH H ARE INCLUDED IN THIS VOLUME DEALING WITH DATA COMPILED FROM THE ADVANCED CYCLE SYSTEMS STUDIES. THEY ARE: DETAILS OF NET PRESENT WORTH APPROACH; NET PRESENT WORTH WITH DISCRETE ANNUAL PAYMENTS; OUTPUT OF NET PRESENT WORTH PROGRAMS; DIRECT WEIGHTING METHOD POWER CYCLE RATINGS; AND

DIRECT WEIGHTING METHOD: UTILITY OBJECTIVES AND IMPACTS OF EVALUATION CRITERIA. (MCW)

DESCRIPTORS BOTTOMING CYCLES;CLOSED-CYCLE MHD GENERATORS;COAL;COAL-FIRED MHD GENERATORS;COMBINED-CYCLE POWER PLANTS: T3;COMPARATIVE EVALUATIONS: Q2;COST;DATA ACQUISITION;ECONOMICS;EFFICIENCY; ELECTRIC UTILITIES;ENERGY CONVERSION;EPRI;EVALUATION: 03.04.05.06.07.08.09;FLUIDIZED-BED COMBUSTORS;FOSSIL-FUEL POWER PLANTS;FUEL CELL POWER PLANTS: T4;GAS TURBINES;HTGR TYPE REACTORS: T9;HYDROCARBON FUEL CELLS;HYDROGEN FUEL CELLS; LIFE-CYCLE COST;LIQUID-METAL MHD GENERATORS;LMFBR TYPE REACTORS: T8;MAGNETOHYDRODYNAMICS;MHD GENERATORS;MHD POWER PLANTS: T5;NUCLEAR FUELS;OPEN-CYCLE MHD GENERATORS;PETROLEUM; POWER GENERATION: T1;POWER PLANTS: T2;RELIABILITY;RESEARCH PROGRAMS;RISK ASSESSMENT;SYSTEMS ANALYSIS: Q1;TECHNOLOGY ASSESSMENT: Q2;THERMIONIC CONVERTERS: T6;THERMODYNAMIC CYCLES: T7;TOPPING CYCLES

F-55

ACCESSION NO. 76X0127961
TITLE(MONO) COMPARATIVE STUDY AND EVALUATION OF ADVANCED-CYCLE SYSTEMS. FINAL REPORT
EDITOR OR COMP POMEROY, B.D.; FLECK, J.J.; MARSH, W.D.; BROWN, D.H.; SHAH, R.P.
CORPORATE AUTH GENERAL ELECTRIC CO., SCHENECTADY, NY (USA)
PAGE NO 163
AVAILABILITY DEP. NTIS, PC A09/MF A01.
DATE FEB 1976
CATEGORIES EDB-296001;200102;300101;300401;300501;210500;210300
PRIMARY CAT EDB-296001
REPORT NO EPRI-AF--664(VOL.2)(PT.1)
ABSTRACT THIS VOLUME PRESENTS 3 APPENDICES (A, B, AND C) CONTAINING DATA DEALING WITH THE ADVANCED POWER CYCLES EVALUATED. THEY ARE: PHASE 1 POWER CYCLES DATA TABULATION; PHASE 2 POWER CYCLES--CONCEPTUAL DESIGNS; AND SUMMARY OF POWER CYCLE DATA AND DEVELOPMENT PLANS FROM THE ENERGY CONVERSION ALTERNATIVES STUDY. THE 19 ADVANCED CYCLES AND THEIR FUELS EVALUATED IN PHASE 1 AND TWO REFERENCE CYCLES (LAST TWO) ARE: ADVANCED STEAM, ATMOSPHERIC FLUIDIZED-BED FURNACE, COAL; ADVANCED STEAM, CONVENTIONAL FURNACE, NO. 6 OIL; ADVANCED STEAM, HIGH-TEMPERATURE GAS-COOLED REACTOR, NUCLEAR; ADVANCED STEAM, LIQUID METAL FAST BREEDER REACTOR, NUCLEAR; ADVANCED OPEN-CYCLE GAS TURBINE, RECUPERATIVE, AIR-COOLED, HIGH BTU GAS DERIVED FROM COAL; ADVANCED OPEN-CYCLE GAS TURBINE, RECUPERATIVE, AIR-COOLED, NO. 6 OIL; ADVANCED OPEN-CYCLE GAS TURBINE, COMBINED-CYCLE, AIR-COOLED, LOW-BTU GAS DERIVED FROM COAL; ADVANCED OPEN-CYCLE GAS TURBINE, COMBINED-CYCLE, WATER-COOLED, LOW-BTU GAS DERIVED FROM COAL; ADVANCED OPEN-CYCLE GAS TURBINE COMBINED-CYCLE, WATER-COOLED, LIQUID SEMICLEAN FUEL DERIVED FROM COAL; CLOSED-CYCLE GAS TURBINE, SUPERCRITICAL CARBON DIOXIDE, ATMOSPHERIC FLUIDIZED-BED, COAL; CLOSED-CYCLE GAS TURBINE, HELIUM ATMOSPHERIC FLUIDIZED-BED, COAL; CLOSED-CYCLE GAS TURBINE, HELIUM, HIGH-TEMPERATURE GAS-COOLED REACTOR, NUCLEAR; OPEN-CYCLE PLASMA MHD, COAL; CLOSED-CYCLE PLASMA MHD, CONVENTIONAL FURNACE, COAL; LIQUID-METAL MHD, ATMOSPHERIC FLUIDIZED-BED, COAL; METAL-VAPOR TURBINE, ATMOSPHERIC FLUIDIZED-BED, COAL; THERMIONIC, CONVENTIONAL FURNACE, COAL; FUEL-CELL, LOW-TEMPERATURE, HYDROGEN DERIVED FROM COAL; FUEL-CELL, LOW-TEMPERATURE, NO. 6 OIL; CONVENTIONAL STEAM WITH STACK GAS SCRUBBING (REFERENCE CASE FOR BASE LOAD AND MIDRANGE) , COAL; AND SIMPLE-CYCLE GAS TURBINE (REFERENCE CASE FOR PEAKING), HIGH-BTU GAS DERIVED FROM COAL. (MCW)

DESCRIPTORS BOTTOMING CYCLES;CLOSED-CYCLE MHD GENERATORS;COAL;COAL-FIRED MHD GENERATORS;COMBINED-CYCLE POWER PLANTS: T3;COMPARATIVE EVALUATIONS: Q2;COST;DATA ACQUISITION;ECONOMICS;EFFICIENCY; ELECTRIC UTILITIES;ENERGY CONVERSION;EPRI;EVALUATION: 03.04.05.06.07.08.09;FLUIDIZED-BED COMBUSTORS;FOSSIL-FUEL POWER PLANTS;FUEL CELL POWER PLANTS: T4;GAS TURBINES;HTGR TYPE REACTORS: T9;HYDROCARBON FUEL CELLS;HYDROGEN FUEL CELLS; LIFE-CYCLE COST;LIQUID-METAL MHD GENERATORS;LMFBR TYPE REACTORS: T8;MAGNETOHYDRODYNAMICS;MHD GENERATORS;MHD POWER PLANTS: T5;NUCLEAR FUELS;OPEN-CYCLE MHD GENERATORS;PETROLEUM; POWER GENERATION: T1;POWER PLANTS: T2;RELIABILITY;RESEARCH PROGRAMS;RISK ASSESSMENT;SYSTEMS ANALYSIS: Q1;TECHNOLOGY ASSESSMENT: Q2;THERMIONIC CONVERTERS: T6;THERMODYNAMIC CYCLES: T7;TOPPING CYCLES

F-56	ACCESSION NO.	78X0127960
	TITLE(MONO)	COMPARATIVE STUDY AND EVALUATION OF ADVANCED-CYCLE SYSTEMS. FINAL REPORT
	EDITOR OR COMP	POMEROY, B.D.; FLECK, J.J.; MARSH, W.D.; BROWN, D.H.; SHAH, R.P.
	CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA)
	PAGE NO	139
	AVAILABILITY	DEP. NTIS, PC A07/MF A01.
	DATE	FEB 1976
	CATEGORIES	EDB-296001;200102;300101;300401;300501;210500;210300
	PRIMARY CAT	EDB-296001
	REPORT NO	EPRI-AF--664(VOL.1)
	ABSTRACT	A NUMBER OF ADVANCED ENERGY-CONVERSION CONCEPTS ARE NOW BEING PROPOSED TO SUPPLEMENT OR SUPERSEDE CONVENTIONAL POWER-GENERATION TECHNOLOGY. THEY ARE BEING PROPOSED BY INDIVIDUALS AND ORGANIZATIONS WITH WIDELY VARIED BACKGROUNDS, USING A DIVERSITY OF APPROACHES AND ASSUMPTIONS FOR PREDICTING PERFORMANCE, COST, AND DEVELOPMENT REQUIREMENTS. THE WORK REPORTED HERE WAS UNDERTAKEN TO ASSIST EPRI IN PLANNING R AND D FOR THE UTILITY INDUSTRY BY ANALYZING 19 OF THE ADVANCED CONCEPTS ON A COMMON BASIS USING UNIFORM TECHNICAL AND ECONOMIC ASSUMPTIONS. THE CONCEPTS RANGE FROM A STEAM CYCLE WITH AN ATMOSPHERIC FLUIDIZED-BED FURNACE TO LONGER-TERM OPTIONS SUCH AS MAGNETOHYDRODYNAMIC SYSTEMS. THE PRIMARY PURPOSE OF THIS STUDY IS TO DEFINE TECHNIQUES FOR ASSESSING THE WORTH OF THESE CONCEPTS TO THE UTILITY INDUSTRY AND THE NATION AS A WHOLE. THREE METHODS HAVE BEEN DEVELOPED: LEVELIZED COST OF ELECTRICITY; DIRECT-WEIGHTING METHOD; AND NET-PRESENT-WORTH METHOD. THESE MEASURE NOT ONLY THE LIFE-CYCLE COSTS ASSOCIATED WITH EACH POWER PLANT CONCEPT, BUT ALSO THE INTANGIBLE ATTRIBUTES SUCH AS DEVELOPMENT RISK AND RELIABILITY. THEY ASSESS THE RELATIVE IMPORTANCE OF COSTS AND INTANGIBLES IN THE CONTEXT OF UTILITY GOALS.
	DESCRIPTORS	BOTTOMING CYCLES;CLOSED-CYCLE MHD GENERATORS;COAL;COAL-FIRED MHD GENERATORS;COMBINED-CYCLE POWER PLANTS: T3;COMPARATIVE EVALUATIONS: Q2;COST;DATA ACQUISITION;ECONOMICS;EFFICIENCY; ELECTRIC UTILITIES;ENERGY CONVERSION;EPRI;EVALUATION: Q3,Q4,Q5,Q6,Q7,Q8,Q9;FLUIDIZED-BED COMBUSTORS;FOSSIL-FUEL POWER PLANTS;FUEL CELL POWER PLANTS: T4;GAS TURBINES;HTGR TYPE REACTORS: T9;HYDROCARBON FUEL CELLS;HYDROGEN FUEL CELLS; LIFE-CYCLE COST;LIQUID-METAL MHD GENERATORS;LMFBR TYPE REACTORS: T8;MAGNETOHYDRODYNAMICS;MHD GENERATORS;MHD POWER PLANTS: T5;NUCLEAR FUELS;OPEN-CYCLE MHD GENERATORS;PETROLEUM; POWER GENERATION: T1;POWER PLANTS: T2;RELIABILITY;RESEARCH PROGRAMS;RISK ASSESSMENT;SYSTEMS ANALYSIS: Q1;TECHNOLOGY ASSESSMENT: Q2;THERMIONIC CONVERTERS: T6;THERMODYNAMIC CYCLES: T7;TOPPING CYCLES

F-57	ACCESSION NO.	78X0124375
	TITLE(MONO)	IMPROVEMENT OF FUEL CELL TECHNOLOGY BASE. TECHNICAL PROGESS REPORT NO. 1, 1 OCTOBER--31 DECEMBER 1977
	CORPORATE AUTH	UNITED TECHNOLOGIES CORP., SOUTH WINDSOR, CT (USA). POWER SYSTEMS DIV.
	PAGE NO	29
	AVAILABILITY	DEP. NTIS, PC A03/MF A01.
	CONTRACT NO	CONTRACT EY-76-C-03-1169
	DATE	30 JAN 1978
	CATEGORIES	EDB-300502;300501
	PRIMARY CAT	EDB-300502
	REPORT NO	FCR--0720
	ABSTRACT	THE PRINCIPAL OBJECTIVE OF THIS PROGRAM IS TO IDENTIFY IMPROVEMENTS IN PHOSPHORIC ACID CELL TECHNOLOGY AND POWER PLANT DESIGN WHICH, IF DEVELOPED, WOULD PERMIT CONSTRUCTION OF A POWER PLANT EQUIVALENT TO THE 4.8-MW DEMONSTRATOR BUT LOWER IN BOTH MANUFACTURING AND OPERATING COST. SUCH IMPROVEMENTS WILL ALSO LEAD TOWARD INCREASED ENDURANCE CAPABILITY. THE DESIGN AND ENDURANCE TESTING OF SEVERAL TEST CELLS ARE DESCRIBED.
	DESCRIPTORS	ACID ELECTROLYTE FUEL CELLS: T1;CATALYSTS;CONTAINERS;COOLING SYSTEMS;COST;DESIGN: Q1,Q2;ELECTRICAL PROPERTIES;ELECTRODES; HIGH-TEMPERATURE FUEL CELLS: T2;OPTIMIZATION;PERFORMANCE TESTING: Q1,Q2;PHOSPHORIC ACID;SERVICE LIFE

F-58

ACCESSION NO. 78J0120065
TITLE PRESENT AND FUTURE OF FUEL CELLS
AUTHORS HATTORI, S.
PUB DESC CHEM. ECON. ENG. REV., NO. 1-2, PP. 13-19
DATE 1976
CATEGORIES EDB-300501
PRIMARY CAT EDB-300501
ABSTRACT A SURVEY COVERS A COMPARISON OF THE THERMAL EFFICIENCY OF FUEL CELLS AND OTHER POWER CONVERSION METHODS; LIMITING FACTORS OF SERVICE LIFE; COST; THE TECHNOLOGY AND STATE OF DEVELOPMENT OF ALKALINE, ACID, FUSED CARBONATE, AND SOLID ELECTROLYTE FUEL CELLS; AND THE ROLE OF FUEL CELL DEVELOPMENT IN JAPAN'S ''SUNSHINE PROJECT'' FOR ENERGY SELF-SUFFICIENCY.
DESCRIPTORS COST;FUEL CELLS: T1;REVIEWS;SERVICE LIFE;TECHNOLOGY ASSESSMENT: Q1;THERMAL EFFICIENCY

F-59

ACCESSION NO. 78C0116310
TITLE HYDROGEN CYCLE PEAK-SHAVING ON THE NEW YORK STATE GRID USING FUEL CELLS
AUTHORS FERNANDES, R.A.; PHILIPP, H.D.
AUTHOR AFF NIAGARA MOHAWK POWER CORP., SYRACUSE, NY
PUB DESC IEEE TRANS. POWER APPAR. SYST., V. PAS-96, NO. 2, PP. 467-477
CONF TITLE IEEE PES SUMMER MEETING
CONF PLACE PORTLAND, OR, USA
CONF DATE 18 JUL 1976
DATE 1977
CATEGORIES EDB-300504;200107;296000
PRIMARY CAT EDB-300504
ABSTRACT A PRELIMINARY ASSESSMENT FOR THE EMPIRE STATE ELECTRIC ENERGY RESEARCH CORPORATION INDICATED THAT POWER SYSTEM NETWORKS MIGHT BE BETTER OPTIMIZED IF DISPERSED STORAGE DEVICES, LOCATED CLOSE TO URBAN AREAS, WERE AVAILABLE. HOWEVER, SOME CAPACITY WOULD BE REQUIRED WHICH COULD OPERATE AS STORED ENERGY PEAK-SHAVING DEVICES AND AS FIRM CAPACITY IN EITHER THE PEAK-SHAVING OR CONTINUOUS INTERMEDIATE GENERATION DUTY REGION OF THE LOAD CURVE. THIS PAPER PRESENTS THE RESULTS OF A COMPREHENSIVE ANALYSIS FOR ''DUAL MODE'' OPERATION OF FUEL CELLS AS AN INTERMEDIATE LOAD GENERATION DEVICE USING COAL DERIVED OR DISTILLATE FUELS DURING CERTAIN PERIODS AND AS PEAK-SHAVING UNITS IN CONJUNCTION WITH ELECTROLYZERS AT OTHER TIMES. IN THE LATTER CASE, HYDROGEN GENERATED BY THE ELECTROLYZER WAS ASSUMED TO BE INJECTED INTO THE NATURAL GAS NETWORK DURING OFF-PEAK ELECTRIC DEMAND PERIODS. DURING PEAK ELECTRIC DEMAND PERIODS AN EQUIVALENT AMOUNT OF BTU'S WOULD BE REMOVED FROM THE GAS NETWORK FOR CONVERSION TO ELECTRICITY. IT IS SHOWN THAT FUEL CELL CAPACITY IN COMBINATION WITH ELECTROLYZERS COULD GENERATE NET ANNUAL SAVINGS TOTALLING $131 MILLION (1974 DOLLARS), INCLUDING A REDUCTION IN FUEL OIL CONSUMPTION OF 30 MILLION BARRELS ANNUALLY BY 1989. OTHER POWER SYSTEM BENEFITS DUE TO FUEL CELL PERFORMANCE CHARACTERISTICS, BOTH STATIC AND DYNAMIC, ARE ANALYZED. THE IMPORTANCE OF THE TYPE OF CONVERTER INTERFACE SELECTED AND THE CORRESPONDING SYSTEM BENEFITS ARE ANALYZED. THE SYSTEM BENEFITS THAT CAN BE DERIVED FROM A FORCE-COMMUTATED DC CONVERTER INTERFACE APPLY EQUALLY WELL TO A DISPERSED DC BATTERY STORAGE SOURCE.
DESCRIPTORS COAL FUEL CELLS;COST;ECONOMIC ANALYSIS;EFFICIENCY;ELECTRIC UTILITIES: T1;ELECTROLYSIS;ELECTROLYTIC CELLS;ENERGY STORAGE SYSTEMS;EQUIPMENT INTERFACES;FEASIBILITY STUDIES: Q3;FUEL CELL POWER PLANTS: T3,Q1,Q2;FUEL CELLS;HYDROCARBON FUEL CELLS; HYDROGEN FUEL CELLS;HYDROGEN GENERATORS;HYDROGEN PRODUCTION; HYDROGEN STORAGE;INVERTERS;LOAD MANAGEMENT;NATURAL GAS;NEW YORK; OFF-PEAK ENERGY STORAGE: T2,Q1,Q3;SIZE;STEAM REFORMER PROCESSES; WATER

F-60

ACCESSION NO. 78C0102858
TITLE PLATINUM-IMPREGNATED PYROPOLYMER REFRACTORY COMPOSITES: A NEW FUEL CELL ELECTROCATALYST
AUTHORS WELSH, L.B. ; YOUTSEY, K.J.; HERVERT, G.L.; LEYERLE, R.W.; BAKER, B.S.; GEORGE, M.A.
AUTHOR AFF UOP INC., DES PLAINES, IL
TITLE(MONO) POWER SOURCE 6. RESEARCH AND DEVELOPMENT IN NON-MECHANICAL ELECTRICAL POWER SOURCES. PROCEEDINGS OF THE 10TH

INTERNATIONAL SYMPOSIUM HELD AT BRIGHTON, SEPTEMBER 13-16 1976

EDITOR OR COMP	COLLINS, D.H. (ED.)
PAGE NO	593-605
CONF TITLE	10. SYMPOSIUM ON RESEARCH AND DEVELOPMENT IN NON-MECHANICAL ELECTRICAL POWER SOURCES
CONF PLACE	BRIGHTON, UK
CONF DATE	13 SEP 1976
PUBL LOC	ACADEMIC PRESS INC., NEW YORK
DATE	1977
DROP NOTE	SEE CONF-7609175--
CATEGORIES	EDB-300503
PRIMARY CAT	EDB-300503
ABSTRACT	A NEW CLASS OF ELECTRICALLY-CONDUCTING, HIGH SURFACE AREA ELECTROCATALYSTS IS BEING EVALUATED IN GAS DIFFUSION ELECTRODES FOR PHOSPHORIC ACID FUEL CELLS OPERATING FROM 140 TO 180$SUP 0$C. THESE MATERIALS ARE PLATINUM-IMPREGNATED COMPOSITE STRUCTURES CONSISTING OF PYROPOLYMER FILMS BONDED TO REFRACTORY SUBSTRATES. PERFORMANCE AND LIFETIME TESTS ARE DISCUSSED USING THESE ELECTROCATALYSTS AS CATHODES IN CELLS WITH PLATINUM-BLACK COUNTER ELECTRODES. STABLE CELL PERFORMANCE IS OBTAINED FROM 140 TO 180$SUP 0$C DURING 500 TO 2000 H LIFE TESTS. THE CHEMICAL AND PHYSICAL PROPERTIES OF THESE MATERIALS ARE DISCUSSED TO INDICATE THE VARIATIONS IN ELECTROCATALYST PROPERTIES AVAILABLE USING THESE MATERIALS.
DESCRIPTORS	ACID ELECTROLYTE FUEL CELLS: T1;CATALYSTS: T2,Q1;CATALYTIC EFFECTS;CATHODES;CHEMICAL PROPERTIES;COMPOSITE MATERIALS; FABRICATION;HIGH-TEMPERATURE FUEL CELLS;PERFORMANCE TESTING: Q2; PHOSPHORIC ACID;PHYSICAL PROPERTIES;PLATINUM;POLYMERS; REFRACTORIES;SERVICE LIFE

99/5/0000036-0000109// (67)

ACCESSION NO.	76J0095045
TITLE	INGENUITY AND EXPERIMENT ARE NEEDED TO ADVANCE SOLAR COOLING
AUTHORS	BECKMAN, W.A.
AUTHOR AFF	UNIV OF WIS, MADISON
PUB DESC	SUNWORLD, NO. 6, PP. 2-6
DATE	NOV 1977
CATEGORIES	EDB-140901
PRIMARY CAT	EDB-140901
ABSTRACT	THE AUTHOR EXAMINES VARIOUS SOLAR COOLING SYSTEMS AND POINTS OUT SOME OF THE OPERATIONAL PROBLEMS THAT MUST BE SOLVED IF SOLAR COOLING IS TO BE USED EXTENSIVELY. ABSORPTION COOLING SYSTEMS, LIQUID DESICCANT SYSTEMS, SOLID DESICCANT SYSTEMS, AND RANKINE CYCLE POWERED COOLING ARE DISCUSSED.
DESCRIPTORS	ABSORPTION REFRIGERATION CYCLE;COMPARATIVE EVALUATIONS; DESICCANTS;PERFORMANCE;RANKINE CYCLE ENGINES;REVIEWS: Q1;SOLAR AIR CONDITIONERS;SOLAR COLLECTORS;SOLAR COOLING SYSTEMS: T1; TECHNOLOGY ASSESSMENT

F-61

ACCESSION NO.	78X0090338
TITLE(MONO)	ADVANCED FUEL CELL DEVELOPMENT. PROGRESS REPORT, OCTOBER--DECEMBER 1977
EDITOR OR COMP	ACKERMAN, J.P.; KINOSHITA, K.; FINN, P.A.; SIM, J.W.; NELSON, P.A.
CORPORATE AUTH	ARGONNE NATIONAL LAB., ILL. (USA)
PAGE NO	29
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
DATE	MAR 1978
CATEGORIES	EDB-300503;360201
PRIMARY CAT	EDB-300503
AUGMENTATION	LIALO$SUB 2$ MATRIX FOR MOLTEN CARBONATE ELECTROLYTES
REPORT NO	ANL--78-16
ABSTRACT	ADVANCED FUEL CELL RESEARCH AND DEVELOPMENT ACTIVITIES IN ARGONNE NATIONAL LABORATORY (ANL) DURING THE PERIOD OCTOBER TO DECEMBER 1977 ARE DESCRIBED. THIS WORK HAS BEEN AIMED AT UNDERSTANDING AND IMPROVING THE PERFORMANCE OF FUEL CELLS HAVING MOLTEN ALKALI-CARBONATE MIXTURES AS ELECTROLYTES; THE FUEL CELLS OPERATE AT TEMPERATURES NEAR 925$SUP 0$K. THE LARGEST PART OF THIS EFFORT HAS BEEN DIRECTED TOWARD DEVELOPMENT OF METHODS FOR FABRICATING AND EVALUATING ELECTROLYTE STRUCTURES FOR THESE CELLS. CELL PERFORMANCE, LIFE, AND COST ARE THE CRITERIA OF OPTIMIZATION. DURING THIS QUARTER,

THE DESIRABLE PHYSICAL CHARACTERISTICS OF LIALO$SUB 2$ PARTICLES, WHICH ACT TO RETAIN THE MOLTEN CARBONATES IN THE ELECTROLYTE STRUCTURE OF THE CELL, HAVE BEEN MORE CLEARLY DEFINED; A LOW TEMPERATURE SYNTHESIS OF THE STABLE $GAMMA$-ALLOTROPE OF LIALO$SUB 2$ HAS BEEN DEVISED; AN EXTENSIVE STUDY OF LIALO$SUB 2$ STABILITY HAS BEGUN; AND ANALYTICAL METHODS HAVE BEEN REFINED FOR SEPARATING LIALO$SUB 2$, IN UNALTERED FORM, FROM CARBONATES. TESTING OF VARIOUS ELECTROLYTE STRUCTURES AND OTHER COMPONENTS IN 7-CM-DIA ROUND CELLS HAS PROVIDED A MEANS FOR EVALUATING NEW ELECTROLYTE DEVELOPMENTS AND VERIFYING A PREVIOUSLY DEVELOPED METHOD FOR PROTECTING THE WET-SEAL AREAS OF A CELL FROM CORROSION.

DESCRIPTORS: ALUMINATES: M3;CARBONATES;CHEMICAL PREPARATION;CORROSION PROTECTION;COST;DESIGN;ELECTROLYTES;FABRICATION: Q4; HIGH-TEMPERATURE FUEL CELLS: M1;LITHIUM COMPOUNDS: M2;MATRIX MATERIALS: M4,Q1;MOLTEN SALTS;OPTIMIZATION;PERFORMANCE;SEALS; SERVICE LIFE;SYNTHESIS: Q2,Q3

F-62

ACCESSION NO. 78R0090337
TITLE(MONO) SOLID POLYMER ELECTROLYTE (SPE) FUEL CELL TECHNOLOGY PROGRAM, PHASE 2/2A. FINAL REPORT
CORPORATE AUTH GENERAL ELECTRIC CO., WILMINGTON, MASS. (USA). AIRCRAFT EQUIPMENT DIV.
SEC REPT NO NASA-CR--151507; TPR--026-4
PAGE NO 96
AVAILABILITY NTIS PC A05/MF A01.
CONTRACT NO CONTRACT NAS9-14345
DATE 15 DEC 1976
CATEGORIES EDB-300502
PRIMARY CAT EDB-300502
REPORT NO N--77-33606
ABSTRACT TEST EVALUATIONS WERE PERFORMED ON A FABRICATED SINGLE SOLID POLYMER ELECTROLYTE CELL UNIT. THE CELL OPERATED AT INCREASED CURRENT DENSITY AND AT HIGHER PERFORMANCE LEVELS. THIS IMPROVED PERFORMANCE WAS OBTAINED THROUGH A COMBINATION OF INCREASED TEMPERATURE, INCREASED REACTANT PRESSURES, IMPROVED ACTIVATION TECHNIQUES AND IMPROVED THERMAL CONTROL OVER THE BASELINE CELL CONFIGURATION. THE CELL DEMONSTRATED A HIGHER ACID CONTENT MEMBRANE WHICH RESULTED IN INCREASED PERFORMANCE. REDUCED CATALYST LOADING AND LOW COST MEMBRANE DEVELOPMENT SHOWED ENCOURAGING RESULTS.
DESCRIPTORS COST;ELECTROLYTES;FUEL CELLS: T1;PERFORMANCE TESTING: Q1; POLYMERS;SOLIDS

F-63

ACCESSION NO. 78R0090330
TITLE(MONO) SOLID POLYMER ELECTROLYTE (SPE) FUEL CELL TECHNOLOGY PROGRAM, PHASE 1/1A. FINAL REPORT
CORPORATE AUTH GENERAL ELECTRIC CO., WILMINGTON, MASS. (USA). AIRCRAFT EQUIPMENT DIV.
SEC REPT NO NASA-CR--151506; TPR--015
PAGE NO 92
AVAILABILITY NTIS PC A05/MF A01.
CONTRACT NO CONTRACT NAS9-14345
DATE 17 OCT 1975
CATEGORIES EDB-300501
PRIMARY CAT EDB-300501
REPORT NO N--77-33605
ABSTRACT A SOLID POLYMER ELECTROLYTE FUEL CELL WAS STUDIED FOR THE PURPOSE OF IMPROVING THE CHARACTERISTICS OF THE TECHNOLOGY. SEVERAL FACETS WERE EVALUATED, NAMELY: (1) REDUCED FUEL CELL COSTS; (2) REDUCED FUEL CELL WEIGHT; (3) IMPROVED FUEL CELL EFFICIENCY; AND (4) INCREASED SYSTEMS COMPATIBILITY. DEMONSTRATED ADVANCES WERE INCORPORATED INTO A FULL SCALE HARDWARE DESIGN. A SINGLE CELL UNIT WAS FABRICATED. A SUBSTANTIAL DEGREE OF SUCCESS WAS DEMONSTRATED.
DESCRIPTORS COST;EFFICIENCY;ELECTROLYTES: Q1;FABRICATION: Q1;FUEL CELLS: T1; POLYMERS;SOLIDS;WEIGHT

TITLE(MONO) ENGINEERING FEASIBILITY OF A [illegible] USING SHALLOW SOLAR PONDS

EDITOR OR COMP PLATT, E.A.; WOOD, R.L.
CORPORATE AUTH CALIFORNIA UNIV., LIVERMORE (USA). LAWRENCE LIVERMORE LAB.
PAGE NO 26
AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT W-7405-ENG-48
DATE 3 APR 1978
CATEGORIES EDB-141000;140909
PRIMARY CAT EDB-141000
REPORT NO UCRL--52397
ABSTRACT THE ECONOMICS WAS ANALYZED OF A FIELD OF SHALLOW SOLAR PONDS THAT PRESUMABLY SUPPLIES THE HEAT FOR A RANKINE CYCLE ENGINE USING REFRIGERANT R-113 FOR THE WORKING FLUID. WHEN OPERATING, THE ENGINE SUPPLIES 150 KW OF SHAFT POWER, 125 KW OF THAT IS AVAILABLE FOR DEEP-WELL IRRIGATION PUMPING. THE SYSTEM COMPONENTS HAVE BEEN CHOSEN TO PRODUCE THE MAXIMUM NET ENERGY--APRIL THROUGH OCTOBER--PER DOLLAR OF INSTALLATION COST. WEATHER DATA ARE FROM INYOKERN, CALIFORNIA, 1962 RECORDS FOR MOST CALCULATIONS. IT WAS ESTIMATED THAT, FOR A PRIVATE INVESTOR, THE REAL INTERNAL RATE OF RETURN FOR THIS INSTALLATION WOULD BE POSITIVE ONLY IF IN THE FORSEEABLE FUTURE THE COST OF CONVENTIONAL ENERGY WERE TO INFLATE 8% FASTER THAN THE COST OF THE COMMODITIES NEEDED BY THE SOLAR SYSTEM. A 17% DIFFERENTIAL INFLATION RATE WOULD PRODUCE A 10% RATE OF RETURN. REDUCTION IN COST OF THE SHALLOW SOLAR PONDS POTENTIALLY COULD REDUCE THE SYSTEM INSTALLATION COST BY ABOUT 20%.
DESCRIPTORS CALIFORNIA;COST;ECONOMICS;ENGINEERING: Q2;FEASIBILITY STUDIES: Q1,Q2;FREONS;INSTALLATION;IRRIGATION: T3;RANKINE CYCLE ENGINES: Q2;REFRIGERANTS;SOLAR COLLECTORS;SOLAR PONDS: T1;SOLAR WATER

F-64 ACCESSION NO. 78R0079402
TITLE(MONO) ASSESSMENT OF THE FUEL CELL'S ROLE IN SMALL UTILITIES. FINAL REPORT
EDITOR OR COMP STEITZ, P.; MAYO, G.; TAYLOR, D.; LEHMAN, H.
CORPORATE AUTH BURNS AND MCDONNELL ENGINEERING CO., KANSAS CITY, MO. (USA)
PAGE NO 210
AVAILABILITY DEP. NTIS, PC A10/MF A01.
DATE FEB 1976
CATEGORIES EDB-300501;290003
PRIMARY CAT EDB-300501
REPORT NO EPRI-EM--696(VOL.1)
ABSTRACT FUEL CELL POWER PLANTS ARE EXPECTED TO HAVE A NUMBER OF UNIQUE FEATURES OF POTENTIAL BENEFIT TO SMALL ELECTRIC UTILITY SYSTEMS INCLUDING EFFICIENT OPERATION, AVAILABILITY IN SMALL UNIT SIZES, HIGH RELIABILITY, A FLAT HEAT RATE CURVE, MINIMAL ENVIRONMENTAL IMPACT, AND A DISPERSED SITING CAPABILITY. THIS STUDY ASSESSED THE ROLE OF FUEL CELLS IN SMALL MUNICIPAL AND RURAL ELECTRIC UTILITY SYSTEMS, IDENTIFIED THE FUEL CELL CHARACTERISTICS MOST IMPORTANT TO ENSURING ITS SUCCESSFUL PENETRATION OF THE SMALL UTILITY MARKET, AND QUANTIFIED THE VALUE TO SMALL UTILITIES OF KEY FUEL CELL CHARACTERISTICS. THE STUDY INVOLVED FIVE TECHNICAL TASKS INCLUDING: (1) ANALYSIS OF SMALL UTILITY CHARACTERISTICS; (2) SELECTION OF SIX REFERENCE SYSTEMS AND EXPANSION FROM 1960 TO 2000 WITH CONVENTIONAL GENERATION; (3) EXPANSION OF THE SIX REFERENCE SYSTEMS WITH FIVE FUEL CELL TYPES AND COMPARISON WITH CONVENTIONAL EXPANSIONS; (4) DETERMINATION OF THRESHOLD VALUES FOR KEY FUEL CELL CHARACTERISTICS; AND (5) QUANTIFICATION OF THE POTENTIAL BENEFITS ASSOCIATED WITH CERTAIN OF THE FUEL CELL'S UNIQUE FEATURES. THE FUEL CELL TYPES EVALUATED IN THIS STUDY INCLUDED A 5-MW FIRST GENERATION FUEL CELL OPERATING ON NAPHTHA AND 1-MW, 5-MW, 10-MW, AND 25-MW ADVANCED FUEL CELLS USING NO. 2 OIL. THE RESULTS OF THE STUDY SHOW THAT THE FUEL CELL HAS THE POTENTIAL FOR SIGNIFICANT PENETRATION INTO THE SMALL UTILITY MARKET, COMPETING WITH CONVENTIONAL GENERATION FROM THE BASE LOAD TO THE INTERMEDIATE AND PEAKING RANGES OF OPERATION, ESPECIALLY IF THE CHARACTERISTICS SPECIFIED FOR THE ADVANCED FUEL CELLS CAN BE ACHIEVED. TYPICAL BREAK-EVEN CAPITAL/COSTS RANGED BETWEEN $250 AND $400/KW FOR THE VARIOUS SCENARIOS. THE MAJOR POTENTIAL LIMITATIONS ON THE UTILIZATION OF THESE FUEL CELL TYPES ARE OIL AVAILABILITY AND PRICE. IF FUTURE OIL PRICES ARE MUCH HIGHER RELATIVE TO OTHER FUELS THAN AT PRESENT, FUEL CELL PENETRATION MAY BE RESTRICTED TO PEAKING AND INTERMEDIATE

RANGE OPERATION.
DESCRIPTORS CHARGES;CONSTRUCTION;COST;ECONOMIC DEVELOPMENT;ECONOMICS: Q1; ELECTRIC UTILITIES;FEASIBILITY STUDIES;FORECASTING;FUEL CELL POWER PLANTS: T1;FUEL OILS;HYDROCARBON FUEL CELLS;MAINTENANCE; MARKET: Q1;NAPHTHA;OPERATION;POWER RANGE 1-10 MW;POWER RANGE 10-100 MW

AUTHORS BARBER, R.E.
AUTHOR AFF BARBER-NICHOLS ENG CO, ARVADA, COLO
PUB DESC SOL. ENERGY, V. 20, NO. 1, PP. 1-6
DATE 1978
CATEGORIES EDB-140700;141000;140909
PRIMARY CAT EDB-140700
ABSTRACT THIS PAPER ADDRESSES THE TECHNICAL AND COST ASPECTS OF THE ORGANIC RANKINE CYCLE AND ITS INTERACTION WITH THE SOLAR COLLECTOR AS A POWER SYSTEM. THE EFFICIENCY AND PRACTICAL CONSIDERATIONS OF THE COMBINED COLLECTOR AND RANKINE SYSTEM SHOW THAT COLLECTOR TEMPERATURES OF 93$SUP 0$C, 150-200$SUP 0$C, AND 315$SUP 0$C ARE OPTIMUM OPERATING CONDITIONS FOR FLAT PLATE, CONCENTRATORS, AND TRACKING CONCENTRATORS RESPECTIVELY. THE PEAK SOLAR CONVERSION EFFICIENCIES OF THESE SYSTEMS ARE APPROXIMATELY 5, 10 AND 11 PER CENT RESPECTIVELY. IT IS ESTIMATED THAT IN A PRODUCTION UNIT THE RANKINE CYCLE COST WILL BE APPROXIMATELY ONE-THIRD OF THE TOTAL SYSTEM COST WITH TWO-THIRDS GOING TO THE COLLECTOR COMPONENT. CONSEQUENTLY, LOW-COST COLLECTORS ARE CRUCIAL FOR COMMERCIALIZATION OF SOLAR RANKINE SYSTEMS.
DESCRIPTORS COMPARATIVE EVALUATIONS;CONCENTRATING COLLECTORS;COST: Q1,Q3; DESIGN: Q1,Q3;ENERGY EFFICIENCY;FLAT PLATE COLLECTORS;HEAT STORAGE;PERFORMANCE;RANKINE CYCLE ENGINES;RANKINE CYCLE POWER SYSTEMS: Q2,T1;REFRIGERANTS;SOLAR CONCENTRATORS;SOLAR ENERGY CONVERSION;SOLAR HEAT ENGINES: T3;SOLAR THERMAL POWER PLANTS: T2;SOLAR TRACKING;TEMPERATURE DEPENDENCE

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ACCESSION NO. 78J0068955
TITLE STRETCHING THE GASOLINE GALLON: AN ENGINEERING APPROACH
AUTHORS BLAKE, S.E.
PUB DESC TRANSP. RES. NEWS, PP. 11-15
DATE WIN 1974
CATEGORIES EDB-330600
PRIMARY CAT EDB-330600
ABSTRACT THERE ARE SEVERAL WAYS TO ACHIEVE GREATER EFFICIENCY IN THE USE OF ENERGY FOR TRANSPORTAION; REDUCE DEMAND FOR THOSE SCARCE RESOURCES, SHIFT TRAVEL FROM HIGH-ENERGY MODES SUCH AS THE AUTOMOBILE TO MORE ENERGY-EFFICIENT MODES SUCH AS PUBLIC TRANSIT, AND REDUCE ENERGY DEMAND PER VEHICLE-MILE BY MORE ENERGY-EFFICIENT VEHICLES. THREE METHODS ARE DISCUSSED FOR REDUCING ENERGY DEMAND PER VEHICLE-MILE: ENGINE IMPROVEMENTS AND ALTERNATIVES; WEIGHT, SIZE, AND SAFETY FACTORS; AND OTHER DESIGN FEATURES. CHANGES AND IMPROVEMENTS MUST OBVIOUSLY BE MADE IN ENGINE DESIGN, VEHICLE SIZE AND WEIGHT, AND SAFETY TO MEET THE GROWING DEMAND FOR TRANSPORTATION SERVICES AND AT THE SAME TIME ACHIEVE EFFICIENCY IN THE USE OF ENERGY. IF ALL THE AVAILABLE TECHNOLOGY IS APPLIED TO EXISTING PASSENGER VEHICLES, THE SAVINGS COULD BE AS GREAT AS 30% OF THE ESTIMATED 1985 PROJECTED FUEL USE. THIS WOULD SUBSTANTIALLY EXTEND THE SUPPLY OF FOSSIL FUELS.
DESCRIPTORS AIR POLLUTION CONTROL;AUTOMOBILES: T1;DESIGN: Q1;FUEL ECONOMY: Q1;GAS TURBINES;POLLUTION CONTROL EQUIPMENT;RANKINE CYCLE ENGINES;SAFETY;SIZE;SPARK IGNITION ENGINES;STRATIFIED CHARGE

F-65 ACCESSION NO. 78R0060361
TITLE(MONO) ENERGY STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 2. DETAILED REPORT
EDITOR OR COMP BEHRIN, E.; BOLGER, J.; HUDSON, C.L.; O'CONNELL, L.G.; RUBIN, B.; SCHWARTZ, M.W.; WAIDE, C.H.; WALSH, W.J.
CORPORATE AUTH CALIFORNIA UNIV., LIVERMORE (USA). LAWRENCE LIVERMORE LAB.
PAGE NO 651

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CONTRACT NO CONTRACT W-7405-ENG-48
DATE 15 DEC 1977
CATEGORIES EDB-330603;330300;330400;250000;330500
PRIMARY CAT EDB-330603
REPORT NO UCRL--52303(VOL.2)
ABSTRACT A TECHNICAL ANALYSIS OF ENERGY STORAGE DEVICES AND ENERGY STORAGE POWER SYSTEMS FOR AUTOMOBILES WAS PERFORMED TO DETERMINE WHICH DEVICES AND POWER SYSTEMS ARE MOST LIKELY TO PROVIDE CREDIBLE ALTERNATIVES TO CURRENT AUTOMOBILE PROPULSION SYSTEMS BETWEEN NOW AND THE YEAR 2000. ELECTROCHEMICAL, MECHANICAL, AND CHEMICAL/THERMAL ENERGY STORAGE DEVICES WERE EXAMINED, AND THE LEADING CANDIDATES IN EACH CATEGORY WERE IDENTIFIED. VARIOUS AUTOMOTIVE POWER SYSTEMS BASED ON THESE STORAGE DEVICES WERE THEN ANALYZED AND COMPARED TO EACH OTHER AS WELL AS TO INTERNAL-COMBUSTION-ENGINE (ICE) AUTOMOBILES DESIGNED FOR COMPARABLE LEVELS OF PERFORMANCE. THE RESULTS SUGGEST THAT SOME ENERGY STORAGE VEHICLES WILL OFFER PERFORMANCE EQUAL TO THAT OF PRESENT-DAY ICE AUTOMOBILES. HOWEVER, ENERGY STORAGE VEHICLES WILL, FOR THE MOST PART, WEIGH MORE AND COST MORE THAN COMPARABLE ICE VEHICLES.
DESCRIPTORS AUTOMOBILES: T1;COMPARATIVE EVALUATIONS;COMPRESSED AIR ENERGY STORAGE;COST;DESIGN;ELASTOMERS;ELECTRIC BATTERIES;ENERGY STORAGE SYSTEMS: T2,Q1;FLYWHEEL ENERGY STORAGE;FLYWHEELS;FUEL CELLS;HEAT ENGINES;HEAT STORAGE;HYBRID ELECTRIC-POWERED VEHICLES;HYBRID SYSTEMS;HYDRAULIC EQUIPMENT;HYDRIDES;HYDROGEN FUELS;PERFORMANCE;PROPULSION;TECHNOLOGY ASSESSMENT: Q2;THERMAL ENERGY STORAGE EQUIPMENT

F-66 ACCESSION NO. 78C0051572
TITLE IMPROVED SYSTEMS FOR ENERGY CONVERSION AND CONSERVATION AS POLLUTION CONTROL ALTERNATIVES: USEPA PROGRAM
AUTHORS BOSTIAN, H.E.; SKOVRONEK, H.S.; MOURNIGHAN, R.E.
AUTHOR AFF ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI
TITLE(MONO) PROCEEDINGS OF THE 12TH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE. VOL. 1
PAGE NO 600-606
CONF TITLE 12. INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE
CONF PLACE WASHINGTON, DC, USA
CONF DATE 28 AUG 1977
PUBL LOC AMERICAN NUCLEAR SOCIETY, INC., LA GRANGE PARK, IL
DATE 1977
DROP NOTE SEE CONF-770804--P1
CATEGORIES EDB-530200;290300;300000;140400;150600;320000
PRIMARY CAT EDB-530200
ABSTRACT THIS PAPER IS AN OVERVIEW OF A USEPA RESEARCH PROGRAM ON ENERGY CONVERSION AND CONSERVATION. THE PROGRAM EMPHASIS IS ON ENVIRONMENTAL PROBLEMS OR BENEFITS OF MORE EFFICIENT ENERGY SYSTEMS OR ONES USING MORE ABUNDANT DOMESTIC ENERGY RESOURCES. MORE EFFICIENT ENERGY SYSTEMS CAN GENERALLY BE CONSIDERED AS ENVIRONMENTALLY ATTRACTIVE ALTERNATIVES BUT THEIR RELATIVE ENVIRONMENTAL-ECONOMIC BENEFITS NEED TO BE DETERMINED. ON THE OTHER HAND, SOME SYSTEMS COULD HAVE UNIQUE POLLUTION CONTROL PROBLEMS BECAUSE OF DIFFERENT OPERATING CONDITIONS, USE OF HIGHER SULFUR FUELS AND FEEDSTOCKS, OR POSSIBLE GENERATION OF HAZARDOUS POLLUTANTS. THE PROGRAM COVERAGE INCLUDES THE ENVIRONMENTAL ASPECTS OF WASTE ENERGY UTILIZATION AND OTHER ENERGY CONSERVATION MEASURES, ADVANCED POWER SYSTEMS SUCH AS MAGNETOHYDRODYNAMICS (MHD), ONES USING HIGH TEMPERATURE TURBINES, AND SOLAR AND GEOTHERMAL ENERGY CONVERSION.
DESCRIPTORS DIRECT ENERGY CONVERSION;ENERGY CONSERVATION: T2;ENERGY CONVERSION: T1;ENVIRONMENTAL IMPACTS: Q1,Q2;FUEL CELLS; GEOTHERMAL ENERGY;MHD GENERATORS;POLLUTION CONTROL;RESEARCH PROGRAMS: Q1,Q2;SOLAR ENERGY;TECHNOLOGY ASSESSMENT;WASTE HEAT UTILIZATION

F-67 ACCESSION NO. 78C0044204
TITLE ENVIRONMENTAL ASSESSMENT OF A 638 MW(E) MOLTEN CARBONATE FUEL CELL POWER PLANT
AUTHORS KALFADELIS, C.D.; CIPRIOS, G.; HOROWITZ, H.H.; SHAW, H.
AUTHOR AFF EXXON RESEARCH AND ENGINEERING CO., LINDEN, NJ
TITLE(MONO) PROCEEDINGS OF THE 12TH INTERSOCIETY ENERGY CONVERSION

ENGINEERING CONFERENCE. VOL. 1

PAGE NO	681-688
CONF TITLE	12. INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	28 AUG 1977
PUBL LOC	AMERICAN NUCLEAR SOCIETY, INC., LA GRANGE PARK, IL
DATE	1977
DROP NOTE	SEE CONF-770804--P1
CATEGORIES	EDB-300501
PRIMARY CAT	EDB-300501
ABSTRACT	THE POTENTIAL POLLUTION ASSOCIATED WITH A CONCEPTUAL BASE LOAD MOLTEN CARBONATE FUEL CELL POWER PLANT WAS ASSESSED. THE ASSESSMENT WAS BASED ON THE SYSTEM DESIGN PREPARED AS PART OF THE ERDA/NASA/NSF ENERGY CONVERSION ALTERNATIVES STUDY (ECAS). AIR POLLUTION IS NOT EXPECTED TO BE A PROBLEM. NO/SUB X/ PRODUCED FROM AIR FIXATION IS MINIMAL IN THIS SYSTEM DUE TO THE LOW TEMPERATURE OF OPERATION (700--750$SUP 0$C). SULFUR IS REMOVED FROM THE SYNTHESIS GAS IMMEDIATELY AFTER COAL GASIFICATION, AND THUS IS NOT A PROBLEM ASSOCIATED WITH THE STEAM PLANT. THE MAJOR ENVIRONMENTAL PROBLEMS ARE SEEN TO BE ASSOCIATED WITH ASH HANDLING AND DISPOSAL FROM GASIFICATION, AND WITH WATER TREATMENT AND COOLING TOWER OPERATION FOR THE STEAM PLANT. IN THE ECAS PROGRAM, THE COST OF ELECTRICITY WAS ESTIMATED TO BE 2.87 CENTS/KWH (MID-1975). OUR ESTIMATE IS 4.4 CENTS/KWH, PRIMARILY DUE TO HIGHER CALCULATED CAPITAL REQUIREMENTS.
DESCRIPTORS	ASHES;CARBONATES;COAL FUEL CELLS;COAL GASIFICATION;COOLING SYSTEMS;COST;DESULFURIZATION;ELEMENTS;ENVIRONMENTAL IMPACTS: Q1; FUEL CELL POWER PLANTS: T1;GASEOUS WASTES;HIGH-TEMPERATURE FUEL CELLS;MOLTEN SALTS;POLLUTION;POWER RANGE 100-1000 MW;TRACE AMOUNTS

99/5/0004038-0000109// 96

ACCESSION NO.	78C0037722
TITLE	ECONOMICS OF RANKINE-CYCLE POWER RECOVERY FROM WASTE PROCESS HEAT
AUTHORS	NULL, H.R.
AUTHOR AFF	MONSANTO CO., ST. LOUIS
TITLE(MONO)	ENERGY USE MANAGEMENT. VOL. 1
EDITOR OR COMP	FAZZOLARE, R.A. (ED.)
PAGE NO	111-118
CONF TITLE	INTERNATIONAL CONFERENCE ON ENERGY USE MANAGEMENT
CONF PLACE	TUCSON, AZ, USA
CONF DATE	24 OCT 1977
PUBL LOC	PERGAMON PRESS INC., ELMSFORD, NY
DATE	1977
DROP NOTE	SEE CONF-771009--P1
CATEGORIES	EDB-320304;290800
PRIMARY CAT	EDB-320304
ABSTRACT	THE ECONOMIC RETURN HAS BEEN DETERMINED FOR POWER RECOVERY VIA RANKINE CYCLE ENGINES FROM WASTE CHEMICAL PROCESS HEAT. A WIDE RANGE OF VARIABLES, SUCH AS POWER COST, WASTE HEAT LOAD, AND TEMPERATURE OF AVAILABLE HEAT HAVE BEEN CONSIDERED. GENERALLY, VERY LARGE WASTE HEAT LOADS ARE REQUIRED FOR PROFITABLE POWER RECOVERY, AND THE TEMPERATURE OF THE AVAILABLE HEAT MUST BE ABOVE 275$SUP 0$F.
DESCRIPTORS	CHEMICAL INDUSTRY: T1;ECONOMICS: Q3;ENERGY CONSERVATION: Q1; HEAT EXCHANGERS;HEAT RECOVERY EQUIPMENT: T3;INDUSTRIAL PLANTS; OPERATION: Q3;PROCESS HEAT;RANKINE CYCLE ENGINES: T2;WASTE HEAT UTILIZATION: Q1,Q2

F-68 ACCESSION NO.	78C0032455
TITLE	COST AND SIZE ESTIMATES FOR AN ELECTROCHEMICAL BULK ENERGY STORAGE CONCEPT
AUTHORS	WARSHAY, M.; WRIGHT, L.O.
AUTHOR AFF	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND
TITLE(MONO)	PROCEEDINGS OF THE SYMPOSIUM ON ENERGY STORAGE
EDITOR OR COMP	BERKOWITZ, J.B.; SILVERMAN, H.P. (EDS.)
PAGE NO	130-140
CONF TITLE	FALL MEETING OF THE ELECTROCHEMICAL SOCIETY
CONF PLACE	DALLAS, TX, USA
CONF DATE	5 OCT 1975
PUBL LOC	THE ELECTROCHEMICAL SOCIETY, INC., PRINCETON, NJ

DATE	1976
DROP NOTE	SEE CONF-751032--
CATEGORIES	EDB-300501;200107
PRIMARY CAT	EDB-300501
ABSTRACT	PRELIMINARY CAPITAL COST AND SIZE ESTIMATES WERE MADE FOR AN ELECTROCHEMICAL BULK ENERGY STORAGE CONCEPT. THE ELECTROCHEMICAL SYSTEM CONSIDERED WAS AN ELECTRICALLY RECHARGEABLE FLOW CELL WITH A TITANIUM TRICHLORIDE PARALLEL BAR TITANIUM TETRACHLORIDE PARALLEL BARS FERRIC CHLORIDE PARALLEL BAR FERROUS CHLORIDE (TICL$SUB 3$ PARALLEL BAR TICL$SUB 4$ PARALLEL BARS FECL$SUB 3$ PARALLEL BAR FECL$SUB 2$ PARALLEL BAR REDOX COUPLE. THE PRELIMINARY CALCULATIONS WERE MADE TO HELP DETERMINE WHETHER THE REDOX-FLOW-CELL SYSTEM HAS AN ATTRACTIVE POTENTIAL AS A BULK ENERGY STORAGE SYSTEM FOR POWER LOAD LEVELING. WITH THE RISE IN DEMAND FOR ELECTRIC POWER, THE PROBLEM FACING THE ELECTRIC UTILITY INDUSTRY OF MEETING PEAK POWER DEMANDS HAS BEEN GROWING MORE ACUTE. BECAUSE PRESENT METHODS OF MEETING PEAK POWER DEMANDS ARE NOT ENTIRELY ADEQUATE, THE ELECTRIC UTILITY INDUSTRY HAS BEEN INTERESTED IN NEW METHODS FOR MEETING PEAK POWER DEMANDS. ON THE BASIS OF CAPITAL COST ESTIMATES, SIZE ESTIMATES, AND SEVERAL OTHER IMPORTANT CONSIDERATIONS, THE REDOX-FLOW-CELL SYSTEM EMERGES AS HAVING GREAT PROMISE AS A BULK ENERGY STORAGE SYSTEM FOR POWER LOAD LEVELING. THE SIZE OF THIS SYSTEM WOULD BE LESS THAN 2 PERCENT OF THAT OF A COMPARABLE PUMPED HYDROELECTRIC PLANT. THE CAPITAL COST OF A 10-MEGAWATT, 60- AND 85-MEGAWATT-HOUR REDOX SYSTEM WOULD BE $189 TO $327 PER KILOWATT. THIS COST COMPARES WELL WITH THAT OF COMPETING SYSTEMS, ESPECIALLY WHEN ONE CONSIDERS THAT FOR MANY SITES A SAVING IN TRANSMISSION COSTS (UP TO $200 PER KW) COULD BE REALIZED WITH THE REDOX SYSTEM. THIS SAVING COULD BE ACHIEVED BECAUSE THE REDOX SYSTEMS COULD BE BUILT IN VARIOUS SIZES AND LOCATED NEAR THE LOAD CENTERS. THE OTHER IMPORTANT FEATURES OF THE REDOX SYSTEM CONTRIBUTING TO ITS POWER-LOAD-LEVELING APPLICATION ARE ITS LOW ADVERSE ENVIRONMENTAL IMPACT, ITS HIGH EFFICIENCY, ITS APPARENT ABSENCE OF CYCLE LIFE LIMITATIONS, AND ITS FAST RESPONSE.
DESCRIPTORS	COST: Q1,Q3;FUEL CELL POWER PLANTS: T3;IRON CHLORIDES;OFF-PEAK ENERGY STORAGE: T2,Q1;PUBLIC UTILITIES;REDOX FUEL CELLS: T1,Q2; SIZE;TITANIUM CHLORIDES

AUTHORS	BROGAN, J.J.
AUTHOR AFF	ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC
TITLE(MONO)	ENERGY AND THE AUTOMOBILE
PAGE NO	31-36
CONF TITLE	ENERGY AND THE AUTOMOBILE FORUM
CONF PLACE	DETROIT, MI, USA
CONF DATE	15 MAY 1973
PUBL LOC	SOCIETY OF AUTOMOTIVE ENGINEERS, WARRENDALE, PA
DATE	1973
DROP NOTE	SEE CONF-730534--
CATEGORIES	EDB-330100;330200;320203
PRIMARY CAT	EDB-330100
ABSTRACT	A REVIEW IS MADE OF AVAILABLE DATA ON FUEL ECONOMIES OF THE CURRENT INTERNAL COMBUSTION ENGINE-POWERED AUTOMOBILES AND OF THOSE WITH ALTERNATIVE POWERPLANTS. COMPARISONS OF FUEL ECONOMIES OF ALL THESE ENGINE SYSTEMS ARE MADE ON THE BASIS OF THE VEHICLE WEIGHT/ENGINE DISPLACEMENT, AND THE VEHICLE WEIGHT ALONE. THE THERMAL EFFICIENCIES ARE ALSO COMPARED. IT IS SHOWN THAT SEVERAL VERSIONS OF THE DIESEL ENGINE WHICH MEET THE 1975 CLEAN AIR ACT STANDARDS AND WHICH ARE ON THE ROAD TODAY ARE MORE EFFICIENT THAN THE CONVENTIONAL INTERNAL COMBUSTION ENGINE OF 1973. MOREOVER, PROTOTYPES OF OTHER ALTERNATIVE SYSTEMS, USING OTHER CYCLES (BRAYTON, RANKINE, STIRLING) UNDER DEVELOPMENT ARE ALSO PROJECTED TO PROVIDE HIGHER EFFICIENCIES THAN THE CONVENTIONAL INTERNAL COMBUSTION ENGINE OF 1973. ALL COMPARISONS ARE MADE USING THE FEDERAL DRIVING CYCLE AS A COMMON REFERENCE.
DESCRIPTORS	AUTOMOBILES: T1;CLEAN AIR ACT;COMPARATIVE EVALUATIONS;DIESEL ENGINES;ENGINES: Q1;FEDERAL TEST PROCEDURE;FUEL ECONOMY;GAS TURBINES;INTERNAL COMBUSTION ENGINES;RANKINE CYCLE ENGINES;SIZE; SPARK IGNITION ENGINES;STIRLING ENGINES;THERMAL EFFICIENCY;

F-69

ACCESSION NO. 78J0021333
TITLE FUEL CELLS: A SLEEPER IN THE ENERGY RACE
AUTHORS ARONSON, R.B.
PUB DESC MACH. DES., V. 49, NO. 4, PP. 20-22, 24
DATE 24 FEB 1977
CATEGORIES EDB-300500
PRIMARY CAT EDB-300500
ABSTRACT THE FUEL CELL MAY ONE DAY BE A SERIOUS COMPETITOR TO LARGE NUCLEAR OR FOSSIL-FUEL POWER PLANTS. BUT, FOR NOW, FUEL CELL POWER GENERATION HAS ITS GREATEST APPEAL AS AN AUXILIARY UNIT IN CONVENTIONAL POWER PLANTS OR FOR ON-SITE POWER GENERATION IN A SINGLE FACTORY OR APARTMENT. ADVANTAGES OF THE FUEL CELL INCLUDE LOW POLLUTANT LEVELS, VIRTUALLY NO SIZE RESTRICTIONS, HIGH EFFICIENCY AND MULTI-FUEL CAPABILITY. PRESENT RESEARCH SUGGESTS THE POSSIBILITY OF USING FUEL OIL AND ULTIMATELY RESIDUAL OIL AND COAL GAS AS FUEL CELL FUELS.
DESCRIPTORS EFFICIENCY;ELECTROLYTES;ENVIRONMENTAL EFFECTS;FORECASTING;FUEL CELL POWER PLANTS;FUEL CELLS: T1;HYDROCARBON FUEL CELLS; INVERTERS;OPERATION;POWER GENERATION;RESEARCH PROGRAMS; TECHNOLOGY ASSESSMENT: Q1;US ERDA;USES

F-70

ACCESSION NO. 78J0021281
TITLE INTERACTION OF BATTERIES AND FUEL CELLS WITH ELECTRICAL DISTRIBUTION SYSTEMS: LINE COMMUTATED CONVERTER INTERFACE
AUTHORS CARROLL, D.P.; WOOD, P.; GAREIS, G.E.; ONG, C.
AUTHOR AFF PURDUE UNIV, WEST LAFAYETTE, INDIANA
PUB DESC IEEE TRANS. POWER APPAR. SYST., V. PAS-96, NO. 4, PP. 1202-1210
DATE 1977
CATEGORIES EDB-250904;300504;200300
PRIMARY CAT EDB-250904
ABSTRACT NONE.
DESCRIPTORS COMPUTERS;DAMPING;DIAGRAMS;ECONOMICS;ELECTRIC BATTERIES; ELECTRICAL EQUIPMENT;EQUIPMENT INTERFACES: Q3;FEASIBILITY STUDIES: Q1,Q2,Q3;FUEL CELLS: T2;INTERACTIONS;LEAD-ACID BATTERIES: T1;POWER SUBSTATIONS;POWER SYSTEMS: T3;PUBLIC UTILITIES;RELIABILITY;SIMULATION;TRANSIENTS;USES: Q1,Q2

F-71

ACCESSION NO. 78R0016573
TITLE(MONO) FUEL CELL BENEFITS: THE PROGRAM MANAGEMENT OFFICE VIEWPOINT
EDITOR OR COMP BURNETT, W.M.
CORPORATE AUTH ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, WASHINGTON, D.C. (USA). DIV. OF CONSERVATION RESEARCH AND TECHNOLOGY
PAGE NO 22
AVAILABILITY DEP. NTIS, PC A02/MF A01.
DATE 1976
CATEGORIES EDB-300501;290003
PRIMARY CAT EDB-300501
REPORT NO TID--27748
ABSTRACT SEVEN STUDIES THAT HAVE PROVIDED INFORMATION IN THE AREA OF FUEL CELL BENEFITS ARE BRIEFLY DISCUSSED, NAMELY: (1) NATIONAL BENEFITS ASSOCIATED WITH COMMERCIAL APPLICATION OF FUEL CELL POWERPLANTS--UNITED TECHNOLOGIES CORPORATION; (2) FUEL CELL BENEFIT ANALYSIS--ARGONNE NATIONAL LABORATORY; (3) ECONOMIC ASSESSMENT OF THE UTILIZATION OF FUEL CELLS IN ELECTRIC UTILITY SYSTEMS--PUBLIC SERVICE ELECTRIC AND GAS COMPANY; (4) THE ROLE AND ALLOWED COSTS OF FUEL CELLS AS ELECTRIC GENERATING DEVICES--BROOKHAVEN NATIONAL LABORATORY; (5) ERDA ELECTRIC UTILITIES STUDY--ERDA; (6) ENERGY CONVERSION ALTERNATIVES STUDY--NASA, LEWIS RESEARCH CENTER; AND (7) ENERGY SAVINGS ANALYSIS--THE MITRE CORPORATION. THESE STUDIES PRESENT A WIDE RANGE OF POSSIBLE BENEFITS WITH VARYING CONCLUSIONS AS TO SPECIFIC BENEFITS. HOWEVER, ALL CONCLUDE THAT FUEL-CELL TECHNOLOGY WARRANTS STRONG GOVERNMENT SUPPORT. THE ERDA PROGRAM OFFICE ANALYZED THE RESULTS OF THESE STUDIES, AND ESTABLISHED A POSITION ON FUEL-CELL BENEFITS. THE RESULTS OF THAT ANALYSIS ARE PRESENTED. THE INFORMATION PRESENTED INCLUDES THE EXPECTED APPLICATIONS OF FUEL CELLS IN THE NEAR TERM (PRIOR TO 1985) AND THE ESTIMATED MARKET PENETRATION IN THE YEAR 1985. FROM THE ESTIMATED MARKET PENETRATION, FUEL AND DOLLAR SAVING

PREDICTIONS ARE DERIVED. A SUMMARY OF OTHER POTENTIAL BENEFITS (ENVIRONMENTAL, SITING, ETC.) IS ALSO PRESENTED. THE ANALYSIS CONCLUDES THAT FUEL CELLS OFFER CONSIDERABLE POTENTIAL BENEFITS AND PREDICTS THAT MOST LIKELY VALUE FOR FUEL SAVINGS IN 1985 IS 275,000 BARRELS PER DAY AND A TAXPAYER BENEFIT OF AT LEAST $1 BILLION ANNUALLY.

DESCRIPTORS: COST BENEFIT ANALYSIS;ECONOMICS: Q1,Q2;FORECASTING;FUEL CELL POWER PLANTS: T2;FUEL CELLS: T1;MARKET;SERVICE LIFE;US ERDA

99/5/0000036-0000109// 104

ACCESSION NO. 78R0004269

TITLE(MONO) GOALS AND GUIDELINES: RANKINE CYCLE PROPULSION SYSTEMS FOR APPLICATION TO URBAN BUSES AND OTHER HEAVY-DUTY VEHICLES

EDITOR OR COMP RENNER, R.A.

CORPORATE AUTH INTERNATIONAL RESEARCH AND TECHNOLOGY CORP., WASHINGTON, D.C. (USA)

SEC REPT NO IRT--301-R; UMTA-CA--06-0031-72-3

PAGE NO 26

AVAILABILITY NTIS $3.00.

DATE 1 DEC 1972

CATEGORIES EDB-330202;330603

PRIMARY CAT EDB-330202

REPORT NO PB--218143

ABSTRACT PRELIMINARY GOALS AND GUIDELINES ARE PRESENTED FOR THE DEVELOPMENT OF LOW-EMISSION RANKINE CYCLE ENGINE (RCE) EXTERNAL COMBUSTION PROPULSION SYSTEMS FOR URBAN TRANSIT VEHICLES. BOTH INTERIM AND LONG-RANGE GOALS FOR POWER SYSTEMS ARE DESCRIBED, SO THAT DEVELOPMENT CAN PROGRESS TOWARD PROTOTYPES HAVING PROPERTIES ACCEPTABLE TO FLEET OPERATORS. UNDER THE CALIFORNIA STEAM BUS PROJECT, THREE CONVENTIONAL 40-FOOT TRANSIT BUSES WERE CONVERTED TO RCE POWER. OPERATIONAL TESTING DEMONSTRATED LOW EXHAUST EMISSIONS AND REDUCED NOISE LEVELS, BUT BOTH WERE JUDGED CAPABLE OF FURTHER IMPROVEMENT. ROAD PERFORMANCE WAS COMPETITIVE WITH CONVENTIONAL DIESEL PROPULSION. THE PURPOSE OF THE GUIDELINES PRESENTED IS TO ADDRESS SEVERAL OF THE PARTICULAR AREAS NEEDING IMPROVEMENT. EMPHASIS IS GIVEN TO THE NEED FOR BETTER FUEL ECONOMY, SYSTEM RELIABILITY, AND ECONOMICAL PRODUCTION. THE GENERAL GUIDELINES COVER ONLY RCE POWER PLANTS, ALTHOUGH GUIDELINES FOR OTHER EXTERNAL COMBUSTION SYSTEMS ARE RECOMMENDED. PRINCIPAL AREAS COVERED IN THE REPORT INCLUDE: (1) A DESCRIPTION OF THE BUS AND ITS CHARACTERISTICS; (2) GENERAL POWER SYSTEM REQUIREMENTS; (3) PERFORMANCE CRITERIA; (4) FUELS AND FUEL ECONOMY; (5) OBJECTIVES FOR REDUCTION OF EMISSIONS, NOISE, AND HEAT RELEASE; (6) OPERATIONAL SAFETY; (7) OPERATING CHARACTERISTICS; (8) RELIABILITY AND MAINTENANCE FACTORS; (9) RESOURCES AND MATERIALS UTILIZATION; (10) PRODUCTION CONSIDERATIONS; (11) COST PROJECTIONS; AND (12) APPLICATIONS.

DESCRIPTORS AUTOMOTIVE FUELS;BUSES: T1;COST;DESIGN: Q3;ECONOMICS;EXHAUST GASES;FUEL ECONOMY;MAINTENANCE;MATERIALS;NOISE;OPERATION; PERFORMANCE;PRODUCTION;RANKINE CYCLE ENGINES: T3,Q1,Q2; RECOMMENDATIONS;RELIABILITY;SAFETY;THERMAL EFFLUENTS;USES; VEHICLES: T2

99/5/0000036-0000109// 105

ACCESSION NO. 78R0004275

TITLE(MONO) TRANSIT BUS PROPULSION SYSTEMS STATE-OF-THE-ART. FINAL REPORT

CORPORATE AUTH BOOZ-ALLEN APPLIED RESEARCH, INC., BETHESDA, MD. (USA)

SEC REPT NO UMTA-IT--06-0025-72

PAGE NO 89

AVAILABILITY NTIS.

DATE AUG 1972

CATEGORIES EDB-330100;330200;330600;330700

PRIMARY CAT EDB-330100

REPORT NO PB--226871

ABSTRACT THE PRESENT STATE-OF-THE-ART OF PROPULSION TECHNOLOGY APPLICABLE TO THE 40-FOOT TRANSIT BUS IS REVIEWED. THE APPLICABLE PROGRAM, TRANSBUS, UTILIZES THE BEST AVAILABLE COMPONENTS AND TECHNOLOGY TO IMPROVE THE PERFORMANCE, SUITABILITY AND PUBLIC ACCEPTABILITY OF THE MOTOR COACH FOR URBAN MASS TRANSPORTATION. MAJOR COVERAGE IS GIVEN TO DIESEL AND GAS TURBINE ENGINES. CLOSED-CYCLE ENGINES SUCH AS RANKINE AND STIRLING ENGINES ARE ALSO COVERED. POWER, WEIGHT, COST, AND ENVIRONMENTAL CONSIDERATIONS, AS WELL AS TRANSMISSION AND POWER

MANAGEMENT; ARE DISCUSSED.

DESCRIPTORS — BUSES: T1;CONTROL SYSTEMS;COST;DIESEL ENGINES;EXHAUST GASES: Q1; FUEL CONSUMPTION;GAS TURBINES;MECHANICAL TRANSMISSIONS;POWER; PROPULSION: Q1;RANKINE CYCLE ENGINES;SPARK IGNITION ENGINES; STIRLING ENGINES;TECHNOLOGY ASSESSMENT;WEIGHT

F-72

ACCESSION NO. — 78K0004111
TITLE(MONO) — IMPROVED CATHODES FOR PHOSPHORIC ACID FUEL CELLS. FINAL REPORT
CORPORATE AUTH — CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO (USA)
PAGE NO — 91
AVAILABILITY — DEP. NTIS, PC A05/MF A01.
DATE — JUN 1977
CATEGORIES — EDB-300503
PRIMARY CAT — EDB-300503
REPORT NO — EPRI-EM--505
ABSTRACT — THE PURPOSE OF THIS RESEARCH HAS BEEN (1) TO EXPLORE ALTERNATIVE CATALYSTS TO PLATINUM FOR O$SUB 2$ REDUCTION IN PHOSPHORIC ACID FUEL CELLS; AND (2) TO ESTABLISH THE FACTORS WHICH CONTROL THE CATALYTIC ACTIVITY OF PLATINUM FOR O$SUB 2$ REDUCTION IN H$SUB 3$PO$SUB 4$. O$SUB 2$ REDUCTION HAS BEEN EXAMINED ON A NUMBER OF ELECTRODE SURFACES WITH BOTH ROTATING DISK AND GAS FED ELECTRODES. PARTICULAR EMPHASIS HAS BEEN PLACED ON TRANSITION METAL MONOMERIC AND POLYMERIC PHTHALOCYANINES. THE IRON AND COBALT COMPLEXES HAVE SUBSTANTIAL ACTIVITY FOR O$SUB 2$ REDUCTION BUT ARE STILL WELL SHORT OF THAT FOR PT AND HAVE LONG-TERM STABILITY PROBLEMS IN 85% H$SUB 3$PO$SUB 4$. SOLUTION-PHASE TRANSITION METAL MACROCYCLICS SUCH AS THE COBALT AND IRON TETRASULFONATED PHTHALOCYANINES ADSORB VERY STRONGLY ON GRAPHITE IN ACID AND ALSO ALKALINE SOLUTIONS. THESE ADSORBED LAYERS HAVE BEEN FOUND TO CATALYZE O$SUB 2$ REDUCTION WITH THE REACTION PROCEEDING THROUGH PEROXIDE IN ACID AND ALKALINE SOLUTIONS. THIS IN SITU CATALYST ADSORPTION TECHNIQUE IS A PROMISING APPROACH TO ELECTROCATALYSIS. AS THE RESEARCH PROCEEDED, IT BACAME INCREASINGLY EVIDENT THAT TRANSITION METAL MACROCYCLICS ARE NOT LIKELY TO BE FOUND THAT ARE SUPERIOR TO PLATINUM IN TERMS OF ACTIVITY AND LIFETIME IN PHOSPHORIC ACID AT TEMPERATURES ABOVE 150$SUP 0$C. CONSEQUENTLY THE OBJECTIVES OF THE PROJECT WERE BROADENED TO INCLUDE THE IDENTIFICATION AND OPTIMIZATION OF THE FACTORS WHICH CONTROL O$SUB 2$ REDUCTION ON PLATINUM IN PHOSPHORIC ACID. KINETIC STUDIES ON PT IN PURIFIED 85% H$SUB 3$PO$SUB 4$ INDICATE O$SUB 2$ REDUCTION VIA TWO PARALLEL MECHANISMS WITH THE NON-PEROXIDE PATHWAY PREDOMINANT OVER THE PEROXIDE PATHWAY. THE TAFEL SLOPE IS -0.12 V/DECADE AT POTENTIALS BELOW THOSE FOR ANODIC FILM FORMATION AND IS ESSENTIALLY INDEPENDENT OF TEMPERATURE OVER THE RANGE 25 TO 150$SUP 0$C. THE HEAT OF ACTIVATION FOR O$SUB 2$ REDUCTION TO WATER IS APPROXIMATELY 10 KCAL/MOLE.
DESCRIPTORS — ACID ELECTROLYTE FUEL CELLS: T2;CATALYSIS;CATALYSTS: Q2; CATALYTIC EFFECTS: Q3,Q4;CATHODES: Q2;COBALT COMPLEXES; IMPURITIES;IRON COMPLEXES;OXYGEN: T1;PHOSPHORIC ACID; PHTHALOCYANINES: T4;PLATINUM: T3;REDUCTION: Q1;SERVICE LIFE; STABILITY;TRANSITION ELEMENT COMPOUNDS

F-73

ACCESSION NO. — 78J0004106
TITLE — POWER PLANTS FOR OUTER SPACE
AUTHORS — ALLEN, J.M.
PUB DESC — BATTELLE TECH. REV., V. 10, PP. 3-8
DATE — FEB 1961
CATEGORIES — EDB-300601;250901;140501
PRIMARY CAT — EDB-300501
ABSTRACT — IT IS INDICATED THAT WEIGHT FACTORS IMPOSE STRINGENT LIMITATIONS UPON ENERGY CONVERSION SYSTEMS IN SPACE VEHICLES. SYSTEMS NOW AVAILABLE OR BEING DEVELOPED, AND THEIR POTENTIALITIES, ARE DISCUSSED. ENERGY SOURCES REFERRED TO INCLUDE CHEMICAL, ATOMIC, AND SOLAR.
DESCRIPTORS — DESIGN: Q2,Q3,Q4;ELECTRIC BATTERIES: Q1,T3;FUEL CELLS: Q1,T4; SOLAR CELLS: Q1,T2;SPACE VEHICLES;SPACECRAFT POWER SUPPLIES: T1; WEIGHT

F-74

ACCESSION NO. — 78C0004107
TITLE — PROGRESS IN THE TARGET NATURAL GAS FUEL CELL POWERPLANT

	DEVELOPMENT PROGRAM
AUTHORS	PODOLNY, W.H.
TITLE(MONO)	TWELFTH WORLD GAS CONFERENCE
PAGE NO	16P. PAPER IGU/E-1-73
CONF TITLE	12. WORLD GAS CONFERENCE
CONF PLACE	NICE, FRANCE
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DATE	1973
DROP NOTE	SEE CONF-730634--
CATEGORIES	EDB-300501
PRIMARY CAT	EDB-300501
ABSTRACT	THE TARGET PROGRAM WAS FORMED IN 1967. THE PROGRAM, WHICH IS JOINTLY FUNDED BY PRATT AND WHITNEY AIRCRAFT AND A NUMBER OF NATURAL GAS COMPANIES IN THE U.S., CANADA AND JAPAN, IS DEDICATED TO THE DEVELOPMENT OF A NEW ENERGY SERVICE OFFERING (IN WHICH A CUSTOMER'S COMPLETE THERMAL AND ELECTRICAL ENERGY NEEDS WOULD BE PROVIDED FROM NATURAL GAS) BASED ON THE FUEL CELL, A DEVICE WHICH ELECTROCHEMICALLY CONVERTS FUEL TO ELECTRICITY. THROUGH THE EFFORTS OF THIS PROGRAM, THE TECHNOLOGY BASE FOR MANUFACTURING FUEL CELL POWERPLANTS IS BEING ESTABLISHED AND APPLICATION EXPERIENCE WITH PROTOTYPE UNITS IS BEING ACQUIRED AT A RATE PROMISING LARGE-SCALE COMMERCIAL USE OF FUEL CELLS WITHIN THIS DECADE. SINCE THE INCEPTION OF THE TARGET PROGRAM, THE RECOGNITION OF PROBLEMS ASSOCIATED WITH FUEL AVAILABILITY, ENVIRONMENTAL QUALITY AND THE ECONOMICS OF ENERGY SUPPLY HAS EXPANDED THE NEED FOR THIS DEVICE BEYOND THE U.S. NATURAL GAS INDUSTRY INTO VIRTUALLY ALL SECTORS OF THE WORLD ENERGY INDUSTRY. THE FUEL CELL RESEARCH AND ENGINEERING PROGRAMS SPONSORED BY TARGET PROVIDE THE BASIS FOR A NEW AND ECONOMIC ELECTRIC GENERATION OPTION THAT COULD HAVE A SUBSTANTIAL GLOBAL IMPACT ON EXTENDING THE LIFE OF OUR FOSSIL FUEL RESOURCES WHILE MAINTAINING A CLEAN ENVIRONMENT FOR FUTURE GENERATIONS.
DESCRIPTORS	AIR POLLUTION;COMMERCIALIZATION;ENVIRONMENTAL IMPACTS;FUEL CELL POWER PLANTS: T2;MARKET;NATURAL GAS FUEL CELLS: T1;RESEARCH PROGRAMS: G1,Q2;TECHNOLOGY ASSESSMENT

TITLE	PERFORMANCE OF SOLAR SOURCE RANKINE CYCLE ENGINE COOLING SYSTEMS
AUTHORS	OLSON, T.J.; BEEKMAN, D.M.; BECKMAN, W.A.; MITCHELL, J.W.
AUTHOR AFF	UNIV. OF WISCONSIN, MADISON
TITLE(MONO)	PROCEEDINGS OF THE 1977 ANNUAL MEETING OF THE AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY. VOLUME 1, SECTIONS 1--13
EDITOR OR COMP	BEACH, C.; FORDYCE, E. (EDS.)
PAGE NO	7.15-7.19
CONF TITLE	SOLAR WORLD MEETING
CONF PLACE	ORLANDO, FLORIDA, USA
CONF DATE	6 JUN 1977
PUBL LOC	AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY, CAPE CANAVERAL, FL
DATE	1977
DROP NOTE	SEE CONF-770603--P1
CATEGORIES	EDB-140901
PRIMARY CAT	EDB-140901
ABSTRACT	LONG TERM RANKINE ENGINE-SOLAR COOLING SYSTEM PERFORMANCE FOR RESIDENTIAL COOLING IS SIMULATED IN ALBUQUERQUE, NEW MEXICO AND MIAMI, FLORIDA. FOR A FIXED COLLECTOR AREA, THERE IS AN OPTIMAL ENGINE SIZE WHICH WILL PROVIDE THE GREATEST FRACTION OF THE COOLING LOAD FROM SOLAR ENERGY, BUT LESS POWER THAN THAT REQUIRED TO MEET A DESIGN DAY LOAD. SIZING TO MEET THE DESIGN DAY LOAD YIELDS POOR RANKINE ENGINE PERFORMANCE AT OFF DESIGN CONDITIONS DURING MOST OF THE SEASON. THERE IS AN OPTIMAL STORAGE SIZE THAT IS LESS THAN THAT RECOMMENDED FOR HEATING SYSTEMS. AN ECONOMIC STUDY SHOWS THAT THE RANKINE ENGINE-SOLAR COOLING SYSTEM STUDIED HERE IS NOT COST EFFECTIVE IN EITHER OF THE LOCATIONS CHOSEN.
DESCRIPTORS	COOLING LOAD;ECONOMICS;FLORIDA;MATHEMATICAL MODELS: Q1;NEW MEXICO;PERFORMANCE: Q1;RANKINE CYCLE ENGINES;SIZE;SOLAR AIR CONDITIONERS: T1;SOLAR COOLING SYSTEMS

F.75 "Fuel Cells for Electric Utilities", E.A. Gillis, Chemical Engineering Progress, Oct. 1980.

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F.82

F.85 "Development of Molten Carbonate Fuel Cell Power Plant", IGT report sponsored by the Department of Energy Project #65034, DOE #DE-AC03-79ET11325. Project Manager, Len Marianowski.

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F.89 "ECAS Phase I Fuel Cell Results", M. Warshay NASA Lewis, Journal of Energy, Vol. 2 Jan-Feb. 1978, pp. 46-52.

PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

Analysis

Flat Plate

Photovoltaic energy conversion systems are a developing technology. Where available, data have been included on photovoltaic technologies still at an early stage of development. Development status is probably best reflected in the amount of data available to characterize efficiency. Of the various photovoltaic technologies, single-crystal silicon cell technology is the most developed. Polycrystalline silicon, cadmium sulfide (CdS), and gallium arsenide (GaAs) technologies are at a less developed stage.

As a function of data availability, the assessment of photovoltaic technology considered individual cells; modules, which are integrated arrays of cells; and systems, which combine modules, structures to support and interconnect modules, and balance of system components to produce an entity capable of serving a load.

Enough information was gathered to allow the determination of the efficiencies of photovoltaic technologies, acquisition cost of photovoltaic power systems, the weight of photovoltaic power systems, and the size (aperture area) of photovoltaic power systems. Data used in the analysis of efficiency are reported in Table 39. Data used in the analysis of acquisition costs are reported in Table 40. Data used in the analysis of operation and maintenance cost, weight, and size are reported in Table 41.

Note that characteristic data for photovoltaic energy conversion systems are reported on a peak kilowatt (kW_p) basis. This is not the same as the average kilowatt basis describing conventional energy conversion systems such as diesels. Although this is the conventional method of reporting the performance of photovoltaic technologies, it is thus difficult to compare different energy technologies on the same basis. Photovoltaic conversion device performance is established under "peak insolation" conditions of one kilowatt per square meter. A very preliminary method might be to multiply system characteristics that are stated on a per peak kilowatt basis by four or five to put system characteristics on a "per average kilowatt" basis.

Applying the appropriate data anlaysis technique — average with standard deviation when sufficient data were available, or average with range — resulted in the following values for these parameters.

Table 39, Part 1. DATA USED IN ANALYSIS OF EFFICIENCY OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

System Type	Efficiency (%)
Silicon — Single Crystal Cell	12.4
	13.8
	13.8
	15.0
	12.7
	11.6
	10.5
	11.3
	12.0
	11.3
	15.1
	15.0
	11.7
	12.6
	12.2
	11.9
	12.0
	13.8
Silicon — Silicon Crystal Module	11.8
	12.8
	9.9
	9.09
	12.3
	12.6
	12.8
	8.5
	8.0
	10.6
	10.1
	11.8
	11.6
	8.8
	7.8
	9.3
	11.0
	12.5
Silicon — Polycrystalline Cell	9.75
	10.1
	10.0
	10.3
	9.6
	8.0
	9.0
	9.5
	12.0
	10.0
	10.0

Table 39, Part 2. DATA USED IN ANALYSIS OF EFFICIENCY OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

System Type	Efficiency (%)
Silicon — Polycrystalline Module	7.8
GaAs — Single Crystal Cell	17.3
	21.0
	16.0
	12.0
	20.0
	20.0
	17.0
GaAs — Polycrystalline Cell	14.5
	13.2
GaAs — Thin Film Cell	6.3
	6.5
	6.0
Amorphous Silicon Cell	5.5
	3.0
	2.8
	2.6
	3.2
	2.5
	5.6
	6.0
Electrochemical Silicon Cell	No data available
Electrochemical GaAs	12.0
CdS/Cu_xS	9.2
	8.7
	6.0
	9.0
	9.15
	9.0
	7.0
	6.0
	9.1
	7.2
	6.7
$Cu_2S/ZnCdS$	7.8
CdSe/ZnSe	5.0
CdS/CdTe Single Crystal	10.5
	12.0

Table 39, Part 3. DATA USED IN ANALYSIS OF EFFICIENCY OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

System Type	Efficiency (%)
CdS/CdTe Thin Film	8.1
	8.7
CdTe/ITO	Range 2.6 to 8.0
CdS/$CuInSe_{1.8}Te_2$	10.1
CdS/$CuIn_{0.3}Ga_{0.7}Se_{1.7}Te_{0.8}$	13.0
$CuInSe_2$/ITO	5.5
	6.7
$CuInSe_{1.8}Te_{0.8}$/ITO	8.3
$CuIn_{0.3}Ga_{0.7}Se_{1.2}Te_{0.8}$	12.3
Cu_2Te/CdTe	4.8
Zn_3P_2	6.1
CdS/InP — Single Crystal	15.0
	14.4
	14.0
	15.0
CdS/InP — Thin Film	5.7
	5.2
	5.0
	5.7
CdS/$CuInSe_2$	6.6
	5.1
InP/ITO	Range 8.3 to 12.4

Table 40. DATA USED IN ANALYSIS OF ACQUISITION COSTS OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

System Type		
Cell Acquisition Cost ($\$/W_{pk}$)	Module Acquisition Cost ($\$/W_{pk}$)	Installed System Acquisition Cost ($\$/W_{pk}$)
8	9.69	19.85
Range 5 to 10	9.26	18.35
	13.05	35.58
	11.07	20.00
	9.00	40.00
	10.87	32.50
		20.54
		18.67
		10.34
		20.04
		34.44

Table 41. DATA USED IN ANALYSIS OF OPERATION AND MAINTENANCE COSTS, WEIGHT, AND SIZE OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEM

System Operation and Maintenance Cost ($\$/W_{pk}$)	Module Weight (lb/W_{pk})	Module Size (ft^2/KW_{pk})
1.40	0.57	107
1.23	0.51	79.33
1.80	0.68	93.67
	0.66	117.3
	0.46	93.1
	0.51	157.8
	0.60	107.6
	0.42	136.81
	0.37	111.1
		184.2
		146.6
		156.8
		161.8
		156.3
		94.2
		219.6
		219.6

Flat Plate Photovoltaic Energy Conversion System Efficiency

The efficiencies of flat plate photovoltaic energy conversion systems are summarized in Table 42. There is no correlation of efficiency with power or module area since photovolatic modules are modular or incremental in capacity. Of the technologies considered, single-crystal silicon cell-based photovoltaics are the most developed technology and are in commercial use. Polycrystalline silicon photovoltaic technology is essentially at experimental status. CdS thin film photovoltaic technology is under intensive development but still essentially in experimental status. GaAs single crystal, GaAs thin film, and amorphous silicon photovoltaic technologies are at experimental status at a more basic level than polycrystalline silicon. Electrochemical photovoltaic and other developing photovoltaic technologies are at a laboratory stage of development. Efficiency data for these developing technologies are very limited and where reported, efficiency values cannot be confidently used in design without recognition of considerable uncertainty.

Acquisition Cost of Photovoltaic Cells (PVCA)

PVCA = $8000/kW_p$

Range = $2000/kW_p$

Limited data are available. Cost refers to single-crystal silicon-based photovoltaic cells because they are currently technically most developed and are most entensively used today.

Acquisition Cost of Flat Plate Photovoltaic Modules (PVMA)

PVMA = $10490/kW_p$

Standard Deviation = $1610/kWp

Data gathered for PVMA are rather consistent and refer to silicon-based photovoltaic modules.

Acquisition Cost of Installed Flat Plate Photovoltaic Energy Conversion Systems (PVSA)

PVSA = $24,570/kW_p$

Standard Deviation = $9360/kW_p$

Parameter value is for photovoltaic energy conversion systems based on single-crystal silicon cells. There is rather a large spread in values for

Table 42, Part 1. EFFICIENCY OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEM

Photovoltaic Energy Conversion System Type	Acronym†	Efficiency (%)	Standard Deviation (SD) or Range* (R) (%)	Remarks
Silicon — single crystal cell	SIES	12.7	SD = 1.4	At 82.4°F (28°C)
Silicon — single crystal module	SIEM	10.6	SD = 1.7	At 82.4°F
Silicon — poly-crystalline cell	SIEP	9.8	SD = 1.0	At 82.4°F
Silicon — poly-crystalline module	SIEPM	7.8	N.A.	Little data — one point
GaAs — single crystal cell	GAES	17.6	SD = 3.1	
GaAs — polycrystalline cell	GAEP	13.9	R = 0.6	Little data — two points
GaAs — thin film cell	GAET	6.3	R = 0.2	Little data — three points
Amorphous silicon cell	ASEC	3.9	SD = 1.5	
CdS/Cu_xS cell	CSEC	7.9	SD = 1.3	
Electrochemical GaAs	N.A.	12.0	N.A.	Developing technology. One data point.
$Cu_2S/ZnCdS$ cell	N.A.	7.8	N.A.	Developing technology. One data point. Thin film technology.
CdSe/ZnSe cell	N.A.	5.0	N.A.	Developing technology. One data point.
CdS/CdTe cell	N.A.	13.8	R = 0.8	Developing technology. Two data points. Single crystal technology.

Table 42, Part 2. EFFICIENCY OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEM

Photovoltaic Energy Conversion System Type	Acronym†	Efficiency (%)	Standard Deviation (SD) or Range* (R) (%)	Remarks
CdS/CdTe cell	N.A.	8.4	R = 0.3	Developing technology. Two data points. Single crystal technology.
CdTe/ITO cell	N.A.	5.6	R = 2.5	Developing technology. Considerable spread of limited data. Single crystal technology.
$CdS/CuInSe_{1.8}Te_2$ cell	N.A.	10.1	N.A.	Developing technology. One data point.
$CdS/CuIn_{0.3}Ga_{0.7}Se_{1.7}Te_{0.8}$ cell	N.A.	13	N.A.	Developing technology. One data point.
$CuInSe_2$/ITO cell	N.A.	6.1	R = 0.6	Developing technology. Two data points. Thin film technology.
$CuInSe_{1.8}Te_{0.8}$/ITO cell	N.A.	8.3		Developing technology One data point.
$CuIn_{0.3}Ga_{0.7}Se_{1.2}Te_{0.8}$/ITO cell	N.A.	12.3		Developing technology. One data point.
Cu_2Te/CdTe cell	N.A.	4.8	N.A.	Developing technology. One data point. Thin film technology.
Zn_3P_2 cell	N.A.	6.1	N.A.	Developing technology. One data point. Single crystal technology.
CdS/InP cell	N.A.	14.6	R = 0.4	Developing technology. Four data points. Single crystal technology.

Table 42, Part 3. EFFICIENCY OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEM

Photovoltaic Energy Conversion System Type	Acronym†	Efficiency (%)	Standard Deviation (SD) or Range* (R) (%)	Remarks
CdS/InP cell	N.A.	5.4	R = 0.3	Developing technology. Four data points. Thin film technology.
$CdS/CuInSe_2$ cell	N.A.	5.9	R = 0.7	Developing technology. Two data points. Thin film technology.
InP/ITO cell	N.A.	10.2	R = 2	Developing technology. Limited data available.

* Standard deviation given when data sufficient to perform meaningful statistical analysis. Range given when only limited data available.

† No acronym assigned to developing technologies.

installed system costs. This is due primarily to the lack of standard system designs because of the state of development of these systems. Each design has substantial engineering costs due to its uniqueness. Many designs were funded under U.S. Government programs and have costs for instrumentation and monitoring factored into their costs.

Weight of Flat Plate Photovoltaic Modules (PVMW)

PVMW = 520 lb/kW_p

Standard Deviation = 110 lb/kW_p

Data are available for experimental modules only. No installed weight data for modules or systems are available.

Size of Photovoltaic Modules (PVMS)

PVMS = 137.81 ft^2/kW_p

Standard Deviation = 42.98 ft^2/kW_p

Size refers to module aperture area, not footprint. Footprint depends on tilt angle of module. Footprint is about two times PVMS. There is no correlation of unit size with capacity (kW_p). This is due to the modular nature of photovoltaic systems. The large amount of data scatter as indicated by the standard deviation is expected because of the experimental nature of these early photovoltaic module design efforts that are suboptimal in their space utilization. Another cause of variation in size is array efficiency. Although all modules are derived from single-crystal silicon photovoltaic cells, efficiency variations lead to different module sizes per kW_p of capacity.

Data for the parameters of operation and maintenance cost, start-up/shutdown time, and lifetime are scarce and insufficient to allow meaningful statistical analysis. Consequently, the best judgement is made based on available information, and results are stated below.

Operations and Maintenance Cost of Flat Plate Photovoltaic Energy Conversion Systems (PVOM)

PVOM = $\$1480/kW_p$

Range = $\$200/kW_p$

Limited data are available to characterize O&M costs.

Start-Up/Shutdown Time

Start-Up Time = 15 seconds to 5 minutes

Limited data are available. Start-up times are longer when motor starting transient loads are present. Faster start-ups are possible, but the system must be oversized to meet motor starting loads. No data are available on shutdown time, but it may be expected to be under one minute.

Lifetime

Lifetime = 20 years

There isn't extensive experience with photovoltaic energy conversion systems that may firmly support a lifetime of 20 years. However, limited data cited in studies and the inherent simplicity and reliability of photovoltaic arrays suggest that a 20-year lifetime is possible.

Thermal Energy Available

None. In general, flat plate photovoltaic systems operate at near ambient temperature conditions. Some designs recover thermal energy from array cooling to provide space heating or warm water, but the bulk of systems are passively cooled by ambient air with no heat recovery.

Availability of Raw Materials

Photovoltaics based on silicon have no constraints on materials availability. Silicon is abundant; about one atom in five in the Earth's crust is a silicon atom. The question is not one of raw materials availability, but of the capability of industry to supply the high purity silicon needed to produce photovoltaics. That is, material availability is ample, but current silicon refining capacity is not sufficient to support a large solar industry.

The two photovoltaic technologies that are major alternatives to silicon are cadmium- and gallium-based cells. Domestic supplies of cadmium and gallium are sufficient to supply annual production rates greater than several thousand megawatts per year. Identified U.S. reserves of cadmium are sufficient to produce enough cells to provide an annual output comparable to U.S. electricity consumption. Known world reserves are about five times domestic reserves and define an upper limit to the energy contribution of cadmium-based photovoltaics of about the total U.S. energy consumption.

Gallium samples should be ample. Most gallium is imported. However, domestic production could be increased if an attempt is made to extract gallium associated with aluminum or zinc ores, and coal.

Mobility

The general assessment is that flat plate photovoltaic energy conversion systems have a low potential for mobility. Because flat plate photovoltaic collectors are subjected to considerable wind loading they must be rack mounted and rigidly fixed. They are also space filling systems because of the low energy flux of sunlight and hence require considerable disassembly and reassembly for proper operation. Photovoltaic energy conversion systems are heavy. Modules alone weigh 520 pounds per peak kilowatt of capacity. For comparison, a 100-KW continuous diesel energy conversion system weighs only 56 pounds per average kilowatt. The photovoltaic system also needs battery storage and power conditioning equipment. So a figure of 1000 pounds per peak kilowatt is not unreasonable. This large weight significantly limits mobility.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 43, 44, 45, and 46, respectively.

Table 43. FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEM OPERATIONAL CONSTRAINTS

Constraint	Effect	Remarks
1. Part load capability	◐	A moderate constraint. Part load efficiency less than full load efficiency, due to input/output inefficiencies of battery storage or because energy must be dumped if storage is fully charged and load is small (grid connected system may absorb excess energy produced, however). Minimization requires careful matching of system to load.
2. Overload capability	●	No overload capability. Even motor starting transients can be a problem if system is not designed to handle it.
3. Load following capability	O	

Overall Assessment: The ordinal score is 2 indicating turn-down capability with high efficiency penalty.

Table 44. FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEM LOCATION CONSTRAINTS

Constraint	Effect	Remarks
1. Water requirements	O	Needed only for cleaning. Deionized/ distilled water may be needed for electric storage batteries (e.g., lead-acid).
2. Manning requirements	O	May be highly automated. Experience is limited. Systems of commercial size (about 500 kW_p) may require normal inspection and maintenance procedures. Larger systems may acquire comparable manning to conventional (e.g., diesel) energy conversion systems.
3. Fuel availability and delivery	◐	Fuel is not required by photovoltaic energy conversion systems. Fuel may be required of the backup system (if used), if the photovoltaic energy conversion system is not designed to meet 100% of load. Fuel not required if system is grid connected.
4. Fuel storage	O	Only as required by backup system (if used).
5. Other	●	Required solar insolation a major constraint. Performance strongly dependent on insolation. Sunny locations maximize performance. Will not perform well at high latitudes with short winter days (i.e., Arctic). May perform adequately during summer at high latitudes. Performance acceptable in lower 48 states.

Overall Assessment: The ordinal score is 3 indicating average locational constraint.

Table 45. RELIABILITY OF FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

Constraint	Effect	Remarks
1. Moving parts	O	
2. Operating temperature	O	Performance is inversely sensitive to temperature.
3. Modularity of design	O	
4. Stress levels	O	
5. Corrosion	O	
6. Other	●	Photovoltaic energy conversion systems are strongly interactive with solar availability. Systems are not generally sized to carry 100% of the load and frequently have a conventional backup system to ensure continuous availability. Systems sized to meet 100% of the load can be expected to perform as designed, but load and insolation characteristics must be factored into the desing analysis.

Overall Assessment: The ordinal score is 3 indicating average reliability.

Table 46. FLAT PLATE PHOTOVOLTAIC ENERGY CONVERSION SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emmissions	Amount of Emissions With Controls	Degree of Difficulty in Meeting More Stringent Regulations
• Thermal Discharge	---	---	---
• Air Pollution			
CO	---	---	---
NO_x	---	---	---
SO_x	---	---	---
HC	---	---	---
Particulates	---	---	---
Others	---	---	---
• Noise	---	---	---
• Odor	---	---	---
• Solid Waste	---	---	---
• Chemical Waste	---	---	---

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

Actively Cooled

Actively cooled photovoltaic energy conversion systems are defined as systems using sunlight concentration to increase the solar flux impinging upon photovoltaic cells. Sunlight concentration reduces photovoltaic cell area requirements as compared to flat plate photovoltaic energy conversion systems but requires reflective surfaces that track the daily and seasonal movements of the sun, although a few such systems use fixed reflectors to augment the solar flux available to flat plate photovoltaic modules. These photovoltaic energy conversion systems are characterized as active because they use some means to cool the photovoltaic cells so efficiency is not degraded by excessively elevated cell temperatures. While flat plate photovoltaics may use the total insolation (direct plus diffuse components); actively cooled photovoltaics may use only the direct component. Tracking the sun tends to offset the loss of the diffuse component of insolation so that for most geographic locations both energy conversion technologies receive about the same annual insolation.

Photovoltaic energy conversion systems are a developing technology. Where available, data have been included on photovoltaic technologies still at an early stage of development. Of the various photovoltaic technologies, single-crystal silicon cell technology is the most developed. For energy conversion parameters other than efficiency, parameter values reported are based on single-crystal silicon photovoltaic cell technology. Multijunction silicon photovoltaic cells, GaAlAs single-crystal cells, and split spectrum photovoltaic energy conversion components are less developed technologies. Thermophotovoltaic and fluorescent photovoltaic energy conversion devices are at the laboratory stage.

As a function of data availability, the assessment of photovoltaic technology considered individual cells; modules, which are integrated arrays of cells; and systems, which combine modules, structures to support and interconnect modules, and balance of system components to produce an entity capable of serving a load.

Enough information was gathered to allow the determination of the efficiencies of photovoltaic cells, modules, and systems; acquisition costs of photovoltaic modules as purchased from the factory, installed cost of modules, installed cost of photovoltaic energy conversion systems; weight of installed

modules, and size of modules (module size is based on the aperture area of the module). Data used in the analysis of efficiency are reported in Table 47. Data used in the analysis of acquisition cost, weight, and size are reported in Table 48.

Note that characteristic data for photovoltaic energy conversion systems are frequently reported on a peak kilowatt (kW_p) basis. This is not the same as the average kilowatt basis describing conventional energy conversion systems such as diesels. Although this is the conventional method of reporting the performance of photovoltaic technologies, it is thus difficult to compare different energy technologies on the same basis. Photovoltaic conversion device performance is established under "peak insolation" cconditions of one kilowatt per square meter. A very preliminary method might be to multiply system characteristics that are stated on a per peak kilowatt basis by four or five to put them on an average kilowatt basis.

Applying the appropriate data analysis technique — average with standard deviation when sufficient data were available, or average with range — resulted in the following values for these parameters.

Actively Cooled Photvoltaic Energy Conversion System Efficiency

The efficiencies of actively cooled photovoltaic energy conversion systems are summarized in Table 49. There is no correlation of efficiency with power or module area since photovoltaic modules are modular or incremental in capacity. Single-crystal silicon cell-based photovoltaics are the most developed technology and are the only technology that has been used in demonstration projects. There is little experience with complete actively cooled photovoltaic systems that are capable of serving a load; however, the limited data on annual system efficiencies that include performance characteristics of balance of system components such as inverters, batteries, and utility interface are consistent. Multijunction silicon cells, GaAlAs single-crystal cells, split spectrum GaAlAs/silicon cells, thermophotovoltaics, and fluorescent concentrators are at the laboratory stage of development and have yet to be demonstrated at the scale of single-crystal silicon cell-based systems. Efficiency data for these developing technologies are limited, and where reported, parametric efficiency values cannot be confidently used in design without recognition of considerable uncertainty.

Table 47. DATA USED IN THE ANALYSIS OF EFFICIENCY OF ACTIVELY COOLED PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

System Type	Efficiency
Silicon — Single crystal cell	15.0
	13.4
	13.0
	13.1
	15.0
	13.2
	14.2
	16.4
	18.3
	18.0
	19.2
	17.0
	17.0
	17.6
	16.6
	14.5
	18.6
	15.5
	15.2
	14.1
	17.8
	14.3
Silicon — Single crystal module	12.0
	9.4
	10.65
	10.2
	7.0
	11.4
	9.2
	11.2
	9.5
	10.3
	9.0
	13.0
	9.0
	12.0
	8.0
	7.25
	9.0
Silicon — Multijunction cell	20.0
	20.4
Silicon — Single crystal cell-based Systems — annual performance including balance of system	8.4
	9.0
	8.33
	8.34

Table 47, Cont. DATA USED IN THE ANALYSIS OF EFFICIENCY OF ACTIVELY COOLED PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

System Type	Efficiency
GaAlAs — Single crystal cell	23.0
	24.7
	20.0
	23.0
	20.0
	23.0
GaAlAs/Silicon — Split spectrum module	28.0
	31.0
	28.5
	30.5
	26.0
	28.5
	27.0
	26.0
	28.0
Silicon — Single crystal thermophotovoltaic module	26.0
Fluorescent concentrator	4.8

Table 48. DATA USED IN THE ANALYSIS OF ACQUISITION COSTS, WEIGHT, AND SIZE OF ACTIVELY COOLED PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

Acquisition Cost							
Modules -not installed ($/kW$_p$)	Modules -not installed ($/ft^2)	Modules -installed ($/ft^2)	System -installed including balance of system ($/kW$_p$)	System -installed including balance of system ($/ft^2)	Weight -installed modules (lb/ft^2)	Weight -installed modules (lb/kW$_p$)	Size -module Aperture area (ft^2/kW$_p$)
9,380	60.9	125.8	34,160	249.9	7.37	930	330
11,570	118.5	165.0	38,500	363.0	10.6	1120	140
8,010	63.7	81.7	35,440	156.7	21.8	2450	150
9,000	62.9	99.2	19,710	213.4			110
11,390	130.7	170.2	30,530	215.5			130
9,200	75.5	114.1	18,780	169.8			120
10,310			20,710				100
							140
							390
							250

Table 49. EFFICIENCY OF ACTIVELY COOLED PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

Photovoltaic Energy Conversion System Type	Acronym†	Efficiency (%)	Standard Deviation (SD) or Range (R) (%)	Remark
Silicon — Single crystal cell	PVCE	15.77	SD = 1.96	Most developed concentrator cell technology. Little data scatter.
Silicon — Single crystal cell module	PVME	9.78	SD = 1.70	
Silicon — Single crystal cell systems — annual efficiency	PVSE	8.52	SD = 0.32	Annual efficiency. Includes balance of system components. Little data scatter.
Silicon — Multijunction cell	N.A.	20.2	R = 0.2	Developing technology.
GaAlAs — Single crystal cell	N.A.	22.28	SD = 1.89	Developing cell technology.
Spilt-spectrum GaAlAs/silicon module	N.A.	28.17	SD = 1.75	Developing technology.
Thermophotovoltaic module	N.A.	26	N.A.	Developing technology. One data point.
Fluorescent concentrator module	N.A.	4.8	N.A.	Developing technology. One data point.

† No acronym assigned to developing technologies.

* Standard deviation given when data sufficient to perform meaningful statistical analysis. Range given when only limited data available.

Acquisition Cost of Actively Cooled Photovoltaic Modules (PVMAK)

PVMAK = $\$9840/kW_p$

Standard Deviation = $\$1310/kW_p$

Cost refers to single-crystal silicon-based photovoltaic cells because they are currently technically most developed and are most extensively used today.

Acquisition Cost of Actively Cooled Photovoltaic Modules (PVMAF)

PVMAF = $\$85.37/ft^2$

Standard Deviation = $\$31.60/ft^2$

Cost refers to single-crystal silicon-based photovoltaic cells. Significant data scatter due to efficiency variations among modules and limited commercialization of technology.

Acquisition Cost of Installed Actively Cooled Photovoltaic Modules (PVMAI)

PVMAI = $\$126.00/ft^2$

Standard Deviation = $\$35.17/ft^2$

Cost refers to single-crystal silicon-based photovoltaic cells.

Acquisition Cost of Actively Cooled Photovoltaic Energy Conversion Systems (PVSAK)

PVSAK = $\$28260/kW_p$

Standard Deviation = $\$8330/kW_p$

Parameter value is for photovoltaic energy conversion systems based on single-crystal silicon cells.

Acquisition Cost of Actively Cooled Photovoltaic Energy Conversion Systems (PVSAF)

PVSAF = $\$228.05/ft^2$

Standard Deviation = $\$74.22/ft^2$

Parameter value is for photovoltaic energy conversion systems based on single-crystal silicon cells. There is rather a large spread in values for installed system costs. This is due primarily to the lack of standard system designs because of the early state of development of these systems. Each design has substantial engineering cost because of its uniqueness. Many

designs were funded under U.S. Government programs and have costs for instrumentation and monitoring factored into their costs.

Size of Actively Cooled Photovoltaic Modules (PVMA)

PVMA = 190 ft^2/kW_p

Standard Deviation = 100 ft^2/kW_p

Size refers to module aperture area, not footprint. Footprint is dependent primarily on latitude of site. Footprint is about two to three times PVMA. There is no correlation of unit size with capacity (kW_p) due to modular nature of photovoltaic systems. The large amount of data scatter as indicated by the standard deviation is expected because of the experimental nature of these early photovoltaic module design efforts that are suboptimal in their space utilization. Although all modules are derived from single-crystal photovoltaic cells, efficiency variations lead to different module sizes per kW_p of capacity.

Data for the parameters of operation and maintenance cost and start-up/shutdown time are unavailable and data for installed module weight and system lifetime are scarce and insufficient to allow meaningful statistical analysis. Consequently, the best judgement is made based on available information and results are stated below.

Weight of Installed Actively Cooled Photovoltaic Modules (PVMWF)

PVMWF = 13.26 lb/ft^2

Standard Deviation = 7.57 lb/ft^2

Based on single-crystal silicon photovoltaic cells.

Weight of Installed Actively Cooled Photovoltaic Modules (PVMWK)

PVMWK = 1500 lb/kW_p

Standard Deviation = 830 lb/kW_p

Based on single-crystal silicon photovoltaic cells. Only three data points. Experience is limited and the large range of installed weight data may be expected because of the experimental nature of these early photovoltaic module design efforts that are suboptimal in module weight minimization.

Operations and Maintenance Cost of Actively Cooled Photovoltaic Energy Conversion Systems (PVAOM)

No data were found. The only basis for photovoltaic energy conversion system O&M costs is the data obtained for the flat plate photovoltaic systems. Requirements for cleaning of reflective surfaces and maintaining sun tracking components may result in somewhat higher O&M costs for actively cooled photovoltaic systems. A preliminary value that should be used with caution is an O&M cost 20% greater than the O&M cost of flat plate system of $\$1480 \pm 200/kW_p$.

PVAOM = $\$1776/kW_p$

Start-Up/Shutdown Time

Start-up time = 15 seconds to 5 minutes

Shutdown time less than one minute

Parameter value is based on information on flat plate photovoltaic energy conversion systems. Longer start-up is expected when transient motor starting loads are present.

Lifetime

Lifetime = 20 years

There isn't extensive experience with photovoltaic energy conversion systems that may firmly support a lifetime of 20 years. However, limited data cited in studies and the inherent reliability of photovoltaic arrays suggest that a 20-year lifetime is possible.

Thermal Energy Available

Thermal energy is recoverable from actively cooled photovoltaic systems at temperatures up to 100°C. The efficiency of silicon-based photovoltaic cells and to a lesser extent GaAs cells are degraded by high operating temperatures. The purpose of active cooling is to keep photovoltaic cell temperature low. Thermal energy available from module cooling may be used for space or water heating.

Availability of Raw Materials

Photovoltaics based on silicon have no constraints on materials availability. Silicon is abundant, about one atom in five in the Earth's

crust is a silicon atom. The question is not one of raw materials availability, but of the capability of industry to supply the high purity silicon needed to produce photovoltaics. That is, material availability is ample, but current silicon refining capacity is not sufficient to support a large solar industry.

The major alternative to silicon is gallium-based cells. Domestic supplies of gallium are sufficient to supply annual production rates greater than several thousand megawatts per year.

Gallium supplies should be ample. Most gallium is imported. However, domestic production could be increased if an attempt is made to extract gallium associated with aluminum or zinc ores or coal.

Concentrator components are made from steel or plastics which are readily available. Support structures are typically made of steel. Special alloy steels are not typically used.

Mobility

The general assessment is that actively cooled photovoltaic energy conversion systems have a low potential for mobility. Because actively cooled photovoltaics collectors are subjected to considerable wind loading they must be rigidly mounted. They are also space filling systems because of the low energy flux of sunlight and hence require considerable disassembly for transport and reassembly for proper operation. Photovoltaic energy conversion systems are heavy. Installed modules weigh 1500 pounds per peak kilowatt of capacity. The photovoltaic system also needs the additional weight of battery storage and power conditioning equipment. A 100-kilowatt continuous diesel energy conversion system weighs only 56 pounds per average kilowatt.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 50, 51, 52, and 53, respectively.

Table 50. ACTIVELY COOLED PHOTOVOLTAIC ENERGY CONVERSION SYSTEM OPERATIONAL CONSTRAINTS

Constraint	Effect	Remarks
1. Part load capability	◓	Moderate constraint part load efficiency less than full load efficiency due to input/output inefficiencies of battery storage or because energy must be dumped if storage is fully charged and load is small (grid connected system may absorb excess energy produced, however). Minimization requires careful matching of system to load.
2. Overload capability	●	No overload capability. Even motor starting transients can be a problem if system not designed to handle it.
3. Load following capability	O	

Overall Assessment: The ordinal score is 2 indicating turn-down capability with high efficiency penalty.

Table 51. ACTIVELY COOLED PHOTOVOLTAIC ENERGY CONVERSION SYSTEM LOCATION CONSTRAINTS

Constraint	Effect	Remarks
1. Water requirments	◓	Moderate constraint. May need deionized/distilled water for cleaning reflector surfaces, electric storage batteries, and as make-up for collector cooling systems.
2. Manning requirements	O	May be highly automated. Experience is limited. Systems of commercial size (about 500 kW_p) may require normal inspection and maintenance procedures. Larger systems may require comparble manning to conventional energy conversion systems.
3. Fuel availability and delivery	◓	Fuel is not required except if backup system is used, especially if system is not designed to meet 100% of load. Fuel not required if system is grid connected.
4. Fuel storage	O	Only as required by backup system (if used)
5. Other	●	Solar insolation is a major constraint. Performance strongly dependent on insolation. Sunny locations maximize performance. Requires clear (rather than hazy) skies to diffuse insolation. Will not perform well at high altitudes with short winter days (i.e. Artic). May perform adequately during summer at high altitudes. Performance acceptable in lower 48 states. Pollution effects may increase diffuse insolation component and degrade system performance. Pollution may also degrade reflector materials due to dirt and chemical attack.

Overall Assessment: The ordinal score is 3 indicating average locational constraints.

Table 52. RELIABILITY OF ACTIVELY COOLED PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

Constraint	Effect	Remarks
1. Moving parts	●	For sun tracking components.
2. Operating temperature	0	
3. Modularity of design	0	
4. Stress levels	0	
5. Corrosion	0	
6. Other	●	Photovoltaic energy conversion systems are highly interactive with solar availability. High reliability can be designed into the system giving consideration to interaction of the system, load, and insolation availability.

Overall Assessment: The ordinal score is 3 indicating average potential environmental constraint.

Table 53. ACTIVELY COOLED PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emmissions	Amount of Emissions With Controls	Degree of Difficulty in Meeting More Stringent Regulations
• Thermal Discharge	---	---	---
• Air Pollution			
CO	---	---	---
NO_x	---	---	---
SO_x	---	---	---
HC	---	---	---
Particulates	---	---	---
Others	---	---	---
• Noise	---	---	---
• Odor	---	---	---
• Solid Waste	---	---	---
• Chemical Waste	---	---	---

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 15		Experimental 14-17%	--------	Si Cells, 0-50°C decreasing with temperature
P. 99		11.8%	105kWpk	Before inverter
		∿8%	--------	After inverter
P. 100		12.8% 9.9%	100kWpk	Optical Coating Labs, Inc. ARCO Solar Inc.
P. 102		9.2% 12.4%	29.5kWpk	overall system efficiency cell efficiency
P. 103		7.04%	200kWpk	overall system efficiency
P. 105		8.6% 13.8%	20kWpk	annual overall efficiency no power conditioning cell efficiency 3X concentration
P. 106		8.5% 9.77%	30kWpk	annual overall efficiency annual before power conditioning
P. 107		13.8%	25kWpk	cell efficiency at 28°C and peak
P. 108		3%	20kWpk	module efficiency CdS/Cu_xS
P. 109		7%	350kWpk	annual overall efficiency including inverter/power conditioning, polycrystalline silicon, Solarex.
P. 125 Silicon PV Cell Production Method	1986 Module Efficiency Goal:		N.A.	Based on advances in Si PV Mass Production Technology
Czochralski	11.7%			
Heat Exchange Method	14.25%			
Edge Defined Film Fed Growth Ribbon	11.4%			

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value: Study	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
Dendritic Web Ribbon	13.3%			
Silicon on Ceramic	10.1%			
P. 126		9.09% @ 253 $Btu/hr/ft^2$ insolation @ array temperature of 137°F	0.44 kWpk(e)	
P. 127	8.2% on Annual basis			Mobil-Tyco Solar Energy Corp. EFG silicon ribbon solar cells
P. 138	5 to 7%		100 kWp(e)	Module efficiency based on module area. Natural Bridges National Monument
P. 139		2.5 to 7.0%	8 kW_{pk}(e)	Array overall efficiency. Experimental single crystal silicon 1173 ft^2
P. 141		15% cell 12.3% (2'X4' module) 12.6% (4'X4' module) 12.8% (4'X8' module)		Single crystal silicon
P. 142		Cell: 11.8% @ 113°F (air collector) 10.7% @ 82.4°F (liquid collector) Collector: 6.2 to 6.6%		PV/thermal collectors, cell efficiencies on module area basis. 2 glazings. Thermal efficiency 32.1% (air) and 42.6% (liquid), single-crystal silicon

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 144		Cell: 12.7% @ 82.4°F		Single crystal silicon
		11.3% @ 125.6°F		
		Module: 8.5% @ 82.4°F	26.87 W_{pk}(e)	
		7.6% @ 125.6°F	24.03 W_{pk}(e)	
		Cell: 11.6% @ 82.4°F		
		10.7% @ 114.8°F		
		Module: 8.0% @ 82.4°F	36.34 W_{pk}(e)	
		7.4% @ 114.8°F	33.50 W_{pk}(e)	
		Cell: 10.5% @ 82.4°F		
		9.6% @		
		Module: 116.2°F 82.4°F	29.83 W_{pk}(e)	
		5.6% @ 116.2°F	27.14 W_{pk}(e)	
		Cell: 11.3% @ 82.4°F		
		10.4% @ 116.2°F		
		Module: 6.6% @ 82.4°F	31.87 W_{pk}(e)	
		6.1% @ 116.2°F	29.30 W_{pk}(e)	
		Cell: 12.0% @ 82.4°F		
		10.7% @ 123.8°F		
		Module: 10.6% @ 82.4°F	77.42 W_{pk}(e)	
		9.4% @ 123.8°F	68.69 W_{pk}(e)	
		Cell: 9.0% @ 82.4°F		Polycrystalline silicon
		Module: 7.8% @ 82.4°F	57.43 W_{pk}(e)	
		Cell: 11.3% @ 82.4°F		Single crystal silicon
		9.9% @ 122°F		
		Module: 10.1% @ 82.4°F	28.77 W_{pk}(e)	
		8.9% @ 122°F	25.26 W_{pk}(e)	

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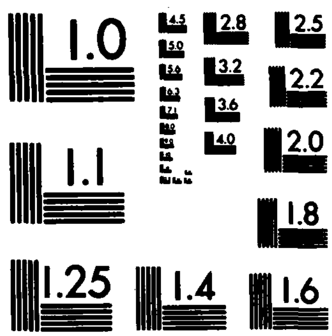

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DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 144, Cont.		Cell: 15.1% @ 82.4°F		Single crystal silicon
		13.7% @ 119.5°F		
		Module: 11.8% @ 82.4°F	80.29 W_{pk}(e)	
		10.7% @ 119.5°F	72.73 W_{pk}(e)	
		Cell: 15.0 @ 82.4°F		
		13.4 @ 119.5°F		
		Module: 11.6% @ 82.4°F	79.31 W_{pk}(e)	
		10.4% @ 119.5°F	70.68 W_{pk}(e)	
		Cell: 11.7% @ 82.4°F		
		10.3% @ 120.9°F		
		Module: 8.8% @ 82.4°F	32.10 W_{pk}(e)	
		7.8% @ 120.9°F	28.44 W_{pk}(e)	
		Cell: 9.0% @ 82.4°F		Edge defined film fed growth (EFG)
		8.2% @ 118.4°F		
		Module: 7.8% @ 82.4°F	37.52 W_{pk}(e)	
		7.1% @ 118.4°F	34.13 W_{pk}(e)	
		Cell: 12.6% @ 82.4°F		Single crystal silicon
		10.7% @ 135.3°F		
		Module: 9.3% @ 82.4°F	6.94 W_{pk}(e)	
		7.9% @ 135.3°F	5.88 W_{pk}(e)	
P. 147	5.5%			Laboratory measurement. Amorphous silicon cell. Small area cell only.
P. 147	3.0%			Laboratory measurement. Amorphous silicon cell. Large area cell only.
P. 147	2.8%			Laboratory measurement. RCA Corp. Amorphous silicon cell. 2.7 x $10^{-2}ft^2$. Single cell only.
P. 147	2.6%			Laboratory measurement. RCA Corp. series connected amorphous silicon cell. 4.0 x $10^{-2}ft^2$

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 147	3.2%			Laboratory measurement Sanyo Electric Co., LTD. AM-1 light @ 316 Btu/Hr ft^2
P. 147	2.5%			Laboratory measurement @ AM-2. Fuji Electric Co., Ltd.
P. 148	15%			Amorphous silicon. Maximum theoritical efficiency.
P. 149	15%			DOE goal for stable and high efficiency cell with single crystal photoelectrode. Electrochemical photovoltaic cell at AM1.
P. 149	10%			DOE goal for stable and moderate efficiency cell with polycrystalline Sio Amorphous photoelectrode at AM1. Electrochemical photovoltaic cell.
P. 150	12%			Laboratory measurement at 300 Btu/Hr Ft^2 AM1. Photo-electrochemical cell. GaAs photoelectrode with surface texturization and ruthenium treatment.
P. 151	9.2%			Achieved efficiency in laboratory. Textured Cds/Cu_2S cell.
	16.1%			Theoretical meximum. Frontwall Cds/Cu_2S cells.
	10.4%			Practical Maximum. Frontwall Cds/Cu_2S cells.
	12%			Theoretical maximum. Backwall Cds/Cu_2S cell.
	7.8%			Practical maximum. Backwall Cds/Cu_2S cells.
	8.7%			Experimental Cds/Cu_2S cell.
	6%			Experimental Cds/Cu_2S cell.
	5.1%			Experimental $Cds/CuInSe_2$ cell (0.03 In^2)
	10.1%			Experimental $Cds/CuInSe_{1.8}Te_2$ cell (0.03 In^2)

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 151	13%			Experimental Cds/Cu $In_{0.3}$ $Ga_{0.7}$ $Se_{1.2}$ $Te_{0.8}$cell (0.03 In^2)
	5.5%			Experimental ITO/Cu In Se_2 cell (1.5×10^{-2} In^2) ITO=Indium Tin Oxide
	8.3%			Experimental ITO/Cu In $Se_{1.8}$ $Te_{0.2}$cell ($1.5 \times 10^{-2} In^2$)
	12.3%			Experimental ITO/Cu $In_{0.3}$ $Ga_{0.7}$ $Se_{1.2}Te_{0.8}$cell ($1.5 \times 10^{-2} In^2$)
P. 152	11%			Laboratory silicon cell efficiency (7.75 In^2) EFG Process. AM1. Mobile Tyco
	12%			Laboratory silicon cell efficiency AM1. Westinghouse WEB process
	9.75%			Experimental polycrystalline silicon. AM1 (1.4 In^2)
	10.1%			Experimental polycrystalline silicon. AM1 (0.3 In^2)
P. 153	12.2%			Experimental SnO_2/n-single crystal silicon. AM1 (0.59 In^2)
	11.1%			Experimental ITO/n-single crystal silicon. AM1 (0.60 In^2)
	>10%			Experimental ITO or SnO_2/n-type polycrystalline (Wacker) silicon. (0.62 In^2)
	10.3%			Experimental diffused-junction cell on polycrystalline (Wacker) silicon.
	14%			Experimental ITO/single crystal silicon. AM1 (0.2 In^2)
	9.6%			Experimental ITO/polycrystalline (Wacker) silicon. AM1 (0.40 In^2)
	9.7%			Experimental ITO/single crystal silicon. AM1 (0.34 In^2)

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency (continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 153	6.8%			Experimental ITO/polycrystalline (Monsanto) silicon. AM1 (0.54 In^2)
	11.9%			Experimental single crystal silicon. AM1 (0.34 In^2)
	8.0%			Experimental polycrystalline (Wacker) silicon. AM1 (0.34 In^2)
	12.7%			Average experimental Dow Corning metallurgical grade epitaxial silicon cell efficiency. Range: 12.4 to 12.9%
P. 154	17.3%			Experimental AMOS (Antireflection Coated Metal Oxide Semiconductor) GaAs cells (0.16 In^2) Single crystal
	14.5%			Experimental AMOS polycrystalline GaAs cell (0.16 In^2)
P. 155	21%			Experimental single crystal shallow homojunction GaAs cells by Chemical Vapor Deposition (CVD) (0.08 In^2) AM1
	16%			Experimental Molecular Bean Epitaxy (MBI) single crystal Ga A_s cells at AM1. (0.01 In^2). Expert substantial improvement.
	12%			Experimental Ion Implanted, Laser Annealed (IILA) single crystal Ga A_s cells. AM1 (0.01 In^2) Expect substantial improvement.
	13.2%			Experimental shallow homojunction polycrystalline Ga A_s cells by CVD process AM1. (0.01 In^2)
	25 to 28%			Estimated efficiency of GaAs Ge Monolithic Tandem cells at AM1 at one sun illumination.
P. 160	15.0%			Experimental single crystal Cds/InP cell AM2. 234 Btu/Hr ft^2 flux
	14.4%			Experimental single crystal Cds/InP cell AM2. 245 Btu/Hr ft^2 flux
	5.7%			Experimental thin flim Cds/InP cell. AM2. 234 Btu/Hr ft^2 flux
	5.2%			Experimental thin flim Cds/InP cell. AM2. 234 Btu/Hr ft^2 flux

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 160	10.5%			Experimental single crystal Cds/CdTe cell. 215 Btu/Hr ft^2 flux
	5.6%			Experimental single crystal Cds/CdTe cell. 269 Btu/Hr ft^2 flux
	8.1%			Experimental Cds/Cd Te thin film cell. 443 Btu/Hr ft^2 flux. AMO
P. 161	6.7%			Experimental Cds/Cd In Se_2
	14%			Experimental single crystal Cds/ InP cell
	5%			Experimental thin film Cds/InP cell
	9%			Experimental CdS/Cu_2S thin film cell
	6.3%			Experimental GaAs thin film cell
	12%			Potential efficiency of GaAs thin film cell
	20%			Experimental: for single crystal Ga As cells
	12%			Indium-Tin Oxide (ITO) on single crystal silicon experimental
	9%			Experimental polycrystalline silicon
P. 162	13.4%			Experimental single crystal silicon cell from Dow Corning process for solar grade silicon AMO.
P. 163	13%			Experimental single crystal silicon cells by Heat Exchanger Method process (HEM). Conventional Spectrolab process range 12.2% to 13.5%
	14.2%			Experimental single crystal silicon cells by HEM process. Texturized cells with Back Surface Field (BSF) Range 13.4% to 14.6%
P. 164	9.5% to 10.6%			Experimental single crystal silicon cells by Ion Implantation into EFG silicon ribbon using both conventional and glow discharge techniques.

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 165	12%			Experimental single crystal silicon cell ($n^+p\ p^+$) by solid source diffusion technique. AM1.
	13.8%			Experimental single crystal silicon cell ($p^+n\ n^+$) by solid source diffusion technique. AM1.
P. 167	16.4%			Experimental single crystal silicon thin film cell (50 MM thick)
P. 168	12 to 21%			Theoretical efficiency of multi-junction amorphous silicon/amorphous Si-Ge alloy cells.

STUDY

P. 169

Absorber/ Collector; Generator/ Convertor	Device Area In^2	Efficiency %	Illumination Btu/Hr ft^2
Si/Si	1.4	9.5	AM1
Cu_2S/Cds	0.14	9.15	279
CdTe/CdS	0.02	8.7	222
Cu_2S/ZnCdS	0.20	7.81	263
$CuInSe_2$/CdS	0.12	6.6	317
GaAs/1-M*	1.4	6.5	AM1
InP/CdS	0.04	5.7	235
α-Si/1-M*	0.003	5.6	206
Cu_2Te/CdTe	0.93	4.8	317
$CuInS_2$/$CuInS_2$	0.02	3.33	317
Cu_2O/Cu	0.16	1.1	317
Zn_3P_2/Mg	0.04	.9	263
Merocyanine/Al	0.16	.7	---
CdSe/ZnTe	0.02	.6	269

Experimental performance of thin film photovoltaic cells

*Insulator-Metal

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 170	7.81%			$CdZnS/Cu_2S$ thin film cell. Experimental. 317 Btu/Hr ft^2. 8.7 In^2
P. 171	5%			Experimental CdSe/ZnSe (CdSe MIS) thin film cell. 317 Btu/Hr ft^2
	10%			Potential CdSe MIS thin film cell efficiency
P. 172	8%			Experimental CdS/CdTe heterojunction cell by vacuum evaporation of CdS
	12%			Experimental CdS/CdS/CdTe heterojunction cell by epitaxial vapor growth of CdS in H_2.
	5.6%			Experimental CdTe/ITO heterojunction cells. Average efficiency range: 2.6% to 8%
	15%			Experimental CdS/InP heterojunction cell
	14%			Experimental ITO/InP heterojuction cell. Maximum reported
	10.2%			Experimental ITO/InP heterojunction cells. Average efficiency range: 8.3% to 12.4%
P. 173	6.1%			Experimental Schottky barrier grid device on Zn_3P_2 single crystals
P. 179	1986 Goal / 1979 Achieved			
	17% / 14%			Advanced Czochralski
	17% / 15%			Heat Exchanger Method (HEM)
	12% / 10%			Edge-Defined Film-Fed Growth (EFG)
	15% / 15%			WEB
	12% / 10.5%			Ribbon-to-Ribbon growth (RTR)
	11% / 10%			Silicon-on-Ceramic (SOC)
P. 180	12%			Experimental improvement of silicon solar cell by laser treatment of of commercial solar cell.
P. 181	11.8%			Experimental silicon cell using screen printing for metallization
P. 184	9%			Experimental 0.16 In^2 CdS/Cu_2S thin film cell. Univ. of Deleware, Institute of Energy Conversion.

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 181	7%			Experimental 7.6 in^2 thin film cell. University of Stuttgart
	6%			Experimental 0.62 in^2 thin film cell. Westinghouse
	2.4%			Experimental 64 in^2 CdS/Cu_2S thin film cell. Designed for large area production. University of Stuttgart.
	4.3%			Experimental 7.6 in CdS/Cu_2S thin film cell. University of Stuttgart.
P. 185	1 to 5%			Experimental CdS/Cu_2S thin film cells by electrophoresis. Large area cells prepared.
P. 187	13%			Simulated efficiency. AlSb cell. Very early development
P. 188	12%			Simulated efficiency AlSb cell. Very early development
P. 191		11%	576 Wpk	Array efficiency. Inverter (DC to AC) is 90% efficient. Solar water pumper.
P. 194	9.1%			Experimental CdS/Cu_2S cell by dipping evaporated CdS film in CuCl Soln.
	7.2%			Experimental planar junction CdS/Cu_2S cell
	6.6%			Experimental thin film evaporated CdS/Cu In Se_2 cell
	11.3%			Experimental Indium Tin Oxide (ITO)/ Cu In Se_2.Single crystalcell
	13%			Experimental $CdS/CuGa_y In_{1-y}Te_{2Z} Se_{2(1-Z)}$. Sintered cell
	6%			Experimental small area amorphous silicon platinum Schottky barrier cells.
	6%			Experimental MIS thin film poly-crystalline GaAs cell on tungsten coated graphite substrate.
	20%			Experimental n^+p GaAs cells on single crystal Ge or GaAs substrate by CVD
	17%			Experimental $Au/Sb_2O_3/GaAs$ cell
	9.5%			Experimental polycrystalline silicon cell by CVD of an epitaxial film on metallurgical grade polycrystalline Si substrate. 1.4 In^2. AM1.

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 194	12%			Experimental polycrystalline silicon cell.
	10%			Experimental polycrystalline silicon cell.
P. 195		12.5%		Module efficiency. Average range: 12 to 13%. AM1 3.9 In^2. AEG-Telefunken
	10%			Experimental polycrystalline silicon cells. 3.9 In^2, 8.7 In^2, 15.5 In^2. AM1. AEG-Telefunken. Heliotronic.
P. 195		6.7%		3.9 In^2. CdS/Cu_2S cell. Small production line established.
P. 196	14%			Experimental ion Implanted silicon cell
	10%			Experimental laser annealed silicon cell

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kw	Assumptions of Advanced State of the Art
P. 100		2904 modules @1.0 x 3.9 ft.	105kWp	Optical Coating Labs, Inc.
	or	1152 modules @0.56 x 1.2m		Arco Solar Inc.
P. 101		3060 modules @3.1ft^2 height (max) 14.1 ft	100kWp	Solarex @1kW/m^2 Insolation rate
P. 102		4,312 modules (shingles) @0.81 ft^2 Total cell area: 2633 ft^2 Total module area: 3459 ft^2	29.5kWp	
P. 103		2400 modules 18610 ft^2 total	200kWp	Solarex, HE354GVM
P. 104		4800 modules @3.44 x 1.44 ft ∿2376 ft^2 array area ∿14520 ft^2 cell area	150kWP	SPC 361
P. 105		2152 ft^2	20kWp	3X CPC, Solarex
P. 107		660 modules @3.67 x 1.41 ft^2	25kWp	Mobil Tyco Mark 2A
P. 108		95.1 x 288.6 ft outline 10734 ft^2 panel area	20kWp	Cds/Cu$_x$S
		84.0 x 115.8 ft outline 3146 ft^2 panel area		Optional Si
		3780 modules	350kWP	1.35X concentration polycrystalline Si
P. 109		@3.9 x 2.0 ft	30120 ft^2	

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 126		48.9 ft^2	0.44kWpk(e)	
P. 132	18,421 ft^2		100 kW_{pk}(e)	Single crystal photovoltaics
P. 139		1173 ft^2	8 kW_{pk}(e)	
P. 144	Modules	3.41ft^2	24.03 W_{pk}(e) @ 125.6°F	Single crystal silicon
		3.41 ft^2	33.50 W_{pk}(e) @ 114.8°F	
		5.20 ft^2	27.14 W_{pk}(e) @ 116.2°F	
		5.20 ft^2	29.30 W_{pk}(e) @ 116.2°F	
		7.88 ft^2	68.69 W_{pk}(e) @ 123.8°F	
		7.88 ft^2	57.43 W_{pk}(e) @ 82.4°F	Polycrystalline silicon
		3.06 ft^2	24.50 W_{pk}(e) @ 122.0°F	Single crystal silicon
		7.34 ft^2	72.73 W_{pk}(e) @ 119.5°F	
		7.34 ft^2	70.68 W_{pk}(e) @ 119.5°F	
		3.93 ft^2	28.44 W_{pk}(e) @ 120.9°F	
		5.16 ft^2	34.13 W_{pk}(e) @ 118.4°F	EFG
		0.80 ft^2	5.88 W_{pk}(e) @ 135.3°F	Single crystal silicon
P. 131,138	2823 ft^2		18 kW_{pk}(e)	Single crystal silicon
P. 131,138	24,264 ft^2		150 kW_{pk}(e)	Single crystal silicon
P. 131,138	30634 ft^2		196 kW_{pk}(e)	Single crystal silicon

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Volume/Size (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 178		1.97 in x 1.97 in (3.9 In^2)	5 kWpk	Silicon photovoltaic dimension
		140 In^2		Module area (36 cells)
		471 ft^2		Array area (486 modules)
P. 192		769 ft^2	3.5 kWpk	24 panels, 32 ft^2 each. Schuchuli Village, Arizona
		384 ft^2	1.8 kWpk	12 panels, 32 ft^2 each. Tanzaye, Upper Volta

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Weight

Energy Conversion System Ref.	Parameter Value: Study	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 144		Modules:		
		13.5 lb; 0.57 lb/W_{pk}	24.03 W_{pk} @ 125.6°F	Single crystal silicon
		17.15 lb; 0.51 lb/W_{pk}	33.50 W_{pk} @ 114.8 °F	
		19.23 lb; 0.68 lb/W_{pk}	27.14 W_{pk} @ 116.2°F	
		19.29 lb; 0.66 lb/W_{pk}	29.30W_{pk} @ 116.2°F	
		32.19 lb; 0.461 lb/W_{pk}	68.69 W_{pk} @ 123.8°F	
		28.78 lb; 0.51 lb/W_{pk}	57.43 W_{pk} @ 82.4°F	Polycrystalline silicon
		15.08 lb; 0.60 lb/W_{pk}	25.26 W_{pk} @ 122.0°F	Single crystal silicon
		29.97 lb; 0.42 lb/W_{pk}	72.73 W_{pk} @ 119.5°F	
		30.03 lb; 0.37 lb/W_{pk}	70.68 W_{pk} @ 119.5°F	EFG
		11.11 lb; 0.40 lb/W_{pk}	28.44 W_{pk} @ 120.9°F	Single crystal silicon

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Startup/Shutdown Time

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 129		Startup 2 min	25 kWpk(e)	Startup slow to avoid high motor starting transients
P. 193		21 sec.	60 kWpk	Startup time.

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: O&M Cost (1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 99		$1.40/Wp	105kWp	
P. 108	$4,310- $5,110		20kWp	
P. 122		$1.23-1.80/Wp		

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Acquisition Cost

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art

P. 125 Gov't Goals:

Year	System Price:	Energy Price:	Module Price:		
1982	\$6-13/W pk	5.2-8.7¢/ kWh	\$2.80/ W_{pk}	Remote Applications	Cost goals are predicated on low cost cell manufacturing techniques and low cost integration of cell into array
1986	\$1.60-2.20/W pk	5.5-9.2¢/ kWh	\$0.70/ W_{pk}	Residential Applications	
1990-2000	\$1.10-1.30/W pk	4.2-8.1¢/ kWh	\$0.15-0.40/ W_{pk}	Utility Applications	

P. 138	\$20-40 W_{pk}(e)	15-28 kWp(e)	System installed costs. Mead, Nebraska irrigation experiment; Bryan, Ohio radio station. Single crystal silicon
P. 140	PV only \$6.97/ft^2 PV/thermal \$11.6/ft^2		Assumes 1986 PV module costs \$0.70/W_{pk}(e) and residential system size 3-10 kW_{pk}(e)

P. 141

Module Size:	Module Cost:	Panel Frame and wiring:	Installation:	Structure:	Total:	Study
2'X2'	\$7.9-8.5/ ft^2	\$3.4-3.7/ft^2	\$ 0.13/ft^2	\$2.8/ft^2	\$14.3-15.3/ft^2	Single crystal silicon
4'X4'	\$7.9-8.9/ ft^2	\$2.7-2.8/ft^2	\$0.13/ft^2	\$ 2.8/ft^2	\$13.6-14.7/ft^2	
4'X8'	\$7.9-10.9/ ft^2	\$2.1-2.3/ft^2	\$ 0.13/ft^2	\$ 2.8/ft^2	\$13.0-16.1/ft^2	

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Acquisition Cost

Energy Conversion System Ref.	Parameter Value Study Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 131 P. 138	FOB Price: $10.87/Wp $27.00/Wp	18 kWp(e)	Single crystal silicon
P. 131	FOB Price: $744/Wp Installation: $40.3/ft^2		Installation includes site preparation; structures and foundations; field wiring; and lightning protection
P. 131	Power Conditioning: $4.00/Wp Total Installed Cost: $34.44/Wp Total Installed Cost: $219.1/ft^2		Total installed cost includes buildings, maintenance equipment and engineering
P. 131 P. 138 P. 131	FOB Price: $9.69/Wp $18.00/Wp $59.9/ft^2 Installation: $21.4/ft^2 Power Conditioning: $1.75/Wp Total Installed Cost: $19.85/Wp Total Installed Cost: $122.7/ft^2	150 kWp(e)	Single crystal silicon Installation includes site preparation; structures and foundations; module installation; field wiring; and lightning protection
P. 131 P. 138 P. 131	FOB Price: $9.26/Wp $19.00/Wp $59.2/ft^2 Installation: $21.4/ft^2 Power Conditioning: $1.84/Wp Total Installed Cost: $18.35/Wp Total Installed Cost: $117.4/ft^2	196 kWp(e)	Single crystal silicon Installation includes site preparation; structures and foundations; module installation; field wiring; and lightning protection Total Installation Cost includes buildings, maintenance equipment, and engineering.
P. 161	$8.3/Wpk to $17.8/Wpk		1978 array price (1980 $)
	$23.7/Wpk to $47.4/Wpk		1978 installed system cost (1980 $)

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Acquisition Cost

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 7	Goal $0.50-$1.30/Wp		Central station size	System cost (without storage)
	$0.10-$0.40/Wp		-------	Array only
	$1.50-$2.50/Wp		-------	Oil conservation baseline technology (system cost)
P. 10	$2.80/Wp		Intermediate	1980 goal
	$0.70/Wp		Intermediate	1982 goal
	$0.50/Wp		---------	1986 goal
P. 99		$32.50/Wp	105kWp	
P. 103		$1280/m^2	200kWp	Array cost (1730m^2)
		$990/m^2		Power conditioning and installation cost
		$82/kWh		Storage battery (2203.2 kWh)
P. 104		$2.8 X 10^6 Total	150kWp	
P. 105	$5-10/Wp			Expectation of cost, cells only
P. 106	$8/Wp			
P. 108	$210,500-203,000		20kWp	Total cost
P. 122		$9.00/Wp		Array cost
		$10.44-11.64		Balance of system cost

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 102		20 years	29.5kWp	design lifetime
P. 106		20 years	30kWp	assumed
P. 140		20 years		assumed lifetime

DATA SHEET

Energy Conversion System: **Photovoltaic-Flat Plate**

Parameters:	Energy Conversion System Reference	
	Studies	Operating Plants
Reliability P. 150 P. 151 P. 189 P. 193	Low. Photoelectrochemical cells still under development CdS/Cu_2S cells are moderately reliable	Moderate to High High
Growth Potential		
Availability of Raw Materials		
Type		
Development		

DATA SHEET

Energy Conversion System: Photovoltaic-Flat Plate

Parameter: Reliability

Energy Conversion System Ref.	Parameter Value: Study	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 129		Moderately high (25 kWpk)		
P. 138		Moderate to high		
P. 139		Moderate (25% module failure rate)		
P. 141	High (assumed)			
P. 143		In 3 yrs, 3% of 4500 modules failed, 2.75 kWpk out of 85 kWpk - A number of sites. Failure due to hail or weathering Silicon PV		
P. 144		Moderate (test modules only)		

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled*

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value: Study	Parameter Value: Operating Plant &Experimental or Under Construction	Plant Size, kW	Assumptions of Advanced State of the Art
P. 15		11-16%		GaAs 482°F (max ∿212°F)
P. 111		12%	72kWpk + ∿100kW$_{th}$	Si
P. 113		9.4% (e)	47kWpk electric	Electric, before power conditioning
		35% (th)	175kW$_{pk}$ thermal	Thermal efficiency (109°F)
P. 114	15%		150kWpk	Electric, basic cell efficiency
	10.65%			Overall electric, concentrator module
P. 115		10.2% (e) 56% (th)	25kWpk(e) 140kWpk(th)	Peak efficiencies
		8.4% (e) 49% (th)		Annual, overall efficiencies
		13.4% (e)		Cell efficiency @ 131°F
P. 116		9.0% (e)	365kWp	PV-mode (electric only)
		11.7% (e & th)	277kWp (e) 208kWp (th)	PV & thermal mode (chilling of water)
P. 117		13%	20kWpk(e)	Cell efficiency @ 131°F (OCLI)
P. 118		13.1%	64kWpk(e) (400kWpk th)	Cell efficiency only, electric
P 119		8.33%	200kWpk(e)	Overall
P. 121		7.0%	162kWpk(e)	Overall collector electrical efficiency
		44.0%	1020kWpk(th)	Overall collector thermal efficiency

*we assume that "actively cooled" refers to concentrator arrays (although concentrator arrays are not always necessarily actively cooled)

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled* (continued)

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Plant Size, kW	Assumptions of Advanced State of the Art
P. 130, 131, 137, 138	12% (measured, P.137)	27 kW_{pk}(e)	E-Systems N-S linear Fresnel lens; single crystal silicon; CR=25 (P.137)
	11.4% @ 300 $Btu/HrFt^2$ @ cell temp. = 132.8°F (measured, P.130)	140kW_{th} @ 114.8°F	
	13% (projected, P. 137)		
	8.43% system electrical efficiency; 48.3% system thermal efficiency (P. 130)		System efficiency is simulated including parasitics
P. 131, 137, 138	7% (measured, P. 137) 9% (projected, P. 137)	110 kW_{pk}(e)	Single crystal silicon; G.E. parabolic troughs, 2-axis tracking; CR=34 (P. 137)
P. 131, 137, 138	7% (measured, P. 137) 8% (projected, P. 137)	47 kW_{pk}(e)	Single crystal silicon; Solar Kinetics N-S parabolic trough; CR=42
P. 137	9-10% (measured) 12% (projected)	500 kW_{pk}(e)	Martin-Marietta Point Focus Fresnel; CR=40; single crystal silicon
	Operating Plant		Modules Only
P. 145	6%		RCA Point Focus Fresnel Lens
	8%		Martin-Marietta Point Focus Fresnel Lens
	5%		Acurex N-S Trough with double cell row
	6%		General Electric Trough with double cell row
	7%		Spectrolab Off Axis Tracking single cell row with secondary reflectors
	4%		Meinel Center Column Receiver

DATA SHEET

Energy Conversion System: Photovoltaic- Actively Cooled

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art

STUDY

Energy Conversion System Ref.	One Sun Efficiency	Peak Efficiency	Concentration Ratio At Peak Peak Efficiency	Cell Area	Manu-facturer	Assumptions of Advanced State of the Art
P. 166	14.9%	16.6%	20	0.98 In^2	OCLI	Experimental silicon cells for concentrator applications at 28°C
	12.1%	14.5%	43	0.98 In^2	OCLI	
	15.3%	18.6%	40	1.58 In^2	Motorola	
	13.1%	15.5%	43	1.52 In^2	Solarex	
	12.0%	15.2%	60	3.02 In^2	Solarex	
	12.2%	14.1%	17	1.86 In^2	General Electric	
	13.5%	17.8%	250	0.36 In^2	RCA	

Energy Conversion System Ref.	Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 167	19%			Thin film silicon cell. Approx. 50 suns. Approx. 77°F
P. 174	23%			Experimental Ga As - Ga Al As cell 100 suns. 77°F
	15%			Experimental Ga As - Ga Al As cell 1000 suns 77°F
P. 175	9%			Overall efficiency of prototype concentrating silicon photovoltaic systems. Include optical and cell efficiency. Optical efficiency 70%.
	28.5%			Experimental spectrum splitting system using Si and Al Ga As cells. 165 suns.
	20%			Expected achievable efficiency. Flourescent concentrator.
	18%			Experimental $p^{+}\eta\ \eta^{+}$ silicon cell. 50 suns
	23%			Experimental Al Ga As/Ga As cells. 1000 suns. AM1
	24.7%			Experimental Al Ga As/Ga As cells. 180 suns.
P. 176	27.0%			Experimental spectrum splitting system using $p^{+}\ \eta\ \eta^{+}$ silicon cell and $Al_{0.93}\ Ga_{0.07}\ As/Al_{0.17}\ Ga_{0.83}$ As cell. 113 suns. 122°F.
	26.0%			Experimental spectrum splitting system using $p^{+}\ \eta\ \eta^{+}$ silicon cell and $Al_{0.93}\ Ga_{0.07}\ As/Al_{0.17}\ Ga_{0.83}$ As cell. 489 suns. 122°F.

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled* (continued)

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Plant Size, kW	Assumptions of Advanced State of the Art
P. 130	11.4% @ 300 $\frac{Btu}{HrFt^2}$ @ cell temp = 133°F Annual electric efficiency = 8.34%	25kWpk(e)	Concentration ratio=25; linear fresnel concentrator. Single crystal silicon cells by Applied Solar Energy Corp. Annual eff. after tracking, transmittance, array electrical losses, and inverter and parasitic losses. Recovers thermal energy.
P. 133	15% @ 86°F @ AM1 - cell efficiency 9.2% @ cell temp. = 149°F, ambient = 95°F with parasitics	$4.5kW_{pk}(e)$	Single crystal silicon. Parabolic trough. Thermal energy recovered. 508 ft^2 aperture area. Carousel tracking. CR=25
P. 134	11.2% @ 166.1°F	$26\ kW_{pk}(e)$	CR=100; carousel tracking, point focusing fresnel; passive cooling
P. 135	Conventional cells: 13.8% @ 82.4°F @ 15 suns 12.6% @ 131°F @ 15 suns Textured cells: 15.8% @ 82.4°F @ 15 suns 14.6% @ 131°F @ 15 suns Overall: Conventional Cells: 9.5% @ 82.4°F @ 15 suns @ 285.7 Btu/Hr Ft^2 8.3% @ 131°F @ 15 suns @ 285.7 Btu/Hr Ft^2 Textured cells: 10.3% @ 82.4°F @ 15 suns 285.7 Btu/Hr Ft^2 9.5% @ 131°F @ 15 suns @ 285.7 Btu/Hr Ft^2		Parabolic trough, 2 axis tracking; silvered, second surface mirrors. Overall efficiency accounts for concentrator optical losses only. Experimental data.
P. 131, 137, 138	5% (measured, P.137) 9% (projected, P. 137)	$60\ kW_{pk}(e)$ (P. 131); $85\ kW_{pk}(e)$ (P. 137,138)	Single crystal silicon, Acurex N-S parabolic trough CR=36 (P.137)

DATA SHEET

Energy Conversion System: Photovoltaic- Actively Cooled

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 177	20%			Experimental Si cell. Microwave Associates. 100 suns. AM1.
	28.5%			Experimental spectrum splitting system using silicon cell and Ga Al As cell. Includes spectral filter efficiency.
P. 182	17%			Experimental $N^{+}P$ siiicon cell. 3.1 In^2. 50 suns. AM1. 82°F
P. 183	14.3%			Average efficiency. Range: 13 to 15.5%. Experimental η+ pn+ (Transcell) for double side illumination application. 15 suns. AML. 0.16 In^2.
	10%			Average efficiency. Range 8.5 to 11.5% Experimental vertical multijunction edge illuminated cell for double side illumination application. 15 suns. AM1.
P. 186	20%			Experimental single crystal GaAs cell by Chemical Vapor Deposition (CVD). η+ p p+ structure. AM1.
	12%			Experimental Ga As cell. Ion Implanted, Laser Annealed process (IILA). AM1
P. 190	18%		20 kW	Ga As cell efficiency @1000 suns. Conservatively estimated. Design goal. Central receiver application
	16%		20 kW	Net Ga As PV array efficiency @ 1000 suns. Conservatively estimated. Design goal. Central receiver application.
P. 194	28%			Experimental spectrum splitting system. Si and Ga As concentrator cells.
P. 196	17.6%			Experimental silicon cell. 50 suns.

DATA SHEET

Energy Conversion System: Photovoltaic- Actively Cooled

Parameter: Efficiency (Continued)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 146	4.8%			Luminescent concentrator Laboratory measurement. CR=32. GaAlAs cell
P. 146	28%			Split-Spectrum cells. Dichroic mirror and Si and GaAlAs cells. Laboratory measurement.
P. 155	30%			Estimated efficiency of GaAs-Ge Monolithic Tandem Cells at AM1 at Multiple sun illumination

P. 156

STUDY

Potential Efficiency	Achieved Efficiency	Concentration Ratio	Cell Technology
16 to 17%	16.4%	25 to 100	Silicon. Single P^+-N
20 to 21%	18.3%	50 to 200	Silicon. BSF P^+-N-N^+
18 to 20%	19.2%	50 to 200	Silicon HLE N^+ -N-P
18 to 20%	17.0%	50 to 200	Silicon. IBC (Interdigitated Back Contact)
22 to 26%	20.4%	100 to 1000	Silicon GVJ (Grooved Vertical Junction)
24 to 26%	23%	500 to 2000	Single Junction GaAlAs
30 to 40%	----	500 to 2000	Multiple Junction Stacks (GaAsSb/GaAlAsSb)
30 to 35%	31%	500 to 2000	Multiple Cell- Spectral Separation (Ga Al As - Si)
30 to 40%	26%	5000 to 10000	Thermophotovoltaic (silicon)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 157	28.5%			Experimental Ga Al As and Si cells (Varian Associates) at 150 suns (AM1.2) Beam splitting two-cell photovoltaic converter.
	20%			Experimental Etched Multiple Vertical Junction Silicon photovoltaic cell (EMVJ) (Microwave Associates). AM1.
P. 159	30.5%			Calculated Efficiency of Beam Splitting two cell photovoltaic converter. Ga Al As and Si cells. 500 suns. AM2.
	26%			Demonstrated efficiency of beam splitting two cell photovoltaic converter. Ga Al As and Si cells. 489 suns. AM1.4
	32.5%			Calculated average efficiency (range: 31.7% to 33.1%) of beam splitting three cell photovoltaic converter Ga Al As, Si, and Ge cells.

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value: Study	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 121		130 modules @ 70 x 34.1 ft. Total area (aperature): 3981 ft^2	162kWp (e) 1020kWp (th)	actively cooled
	Study			
P. 130	2636 Ft^2 10 arrays with 10 collectors each, 24 Ft^2 aperture/collector		25kW$_{pk}$(e)	Linear Fresnel concentrator
P. 133	506 Ft^{2}aperture area		4.5kW$_{pk}$(e)	Parabolic trough with thermal energy recovery. Carousel tracking
P. 134	82 Ft diameter (535 Ft^2)		26kW$_{pk}$(e)	Overall dimension. Carousel tracking; point focusing Fresnel; passive cooling
P. 131, 137 138	6 Ft x 10 Ft (module, P.137) 13095 Ft^2 (Total array P.131)		60kW$_{pk}$(e) (P. 131) 85kW$_{pk}$(e) (P.137, 138)	Single crystal silicon parabolic trough N-S horizontal
P. 130, 131, 137, 138	3 Ft x 10 Ft (module, P.137) 2636 Ft^2 (Total array. P.131)		27kW$_{pk}$(e) (P.131)	Single crystal silicon linear Fresnel lens N-S tilted
P. 131, 137 138	7 Ft x 10 Ft (module, P.137) 13837 Ft^2 (Total array, P.137 138)		110kW$_{pk}$(e)	Single crystal silicon parabolic troughs 2 axis tracking
P. 131, 137 138	7 Ft x 20 Ft (module) 6725 Ft^2 (Total array)		47kW$_{pk}$(e)	Single crystal silicon parabolic troughs N-S horizontal
P. 128, 131 138	13073 Ft^2 (Total array)		150kW$_{pk}$(e) @ 113°F	Polycrystalline silicon reflector augmented flat plate

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 111		52 arrays @ 4.6 X 9.1m	72kW pk (e) +100kW$_{th}$	
P. 112		59 arrays @ 24m diameter @240 modules (array field ~ 300 X 1200m)	500kW$_{pk(e)}$	passively cooled
P. 113		84 arrays @ 1.22 X 6.10m (total collection area 624m^2)	47kWpk(e) +175kWp$_{(th)}$	actively cooled
P. 114		15 subarray units @ 139.4m^2 aperture = 2091m^2 total	150kWpk(e)	
P. 115		11 array units @2.44 X 0.91m aperture 245 m^2 total	25kWpk(e)	actively cooled
P. 116		9 turntables @46m diameter (swept) each turntable: 24 collectors @ 19.5m^2 aperture Total aperature = ~ 4000m^2	350kWpk(e)	actively cooled
P. 117		223m^2 aperture area total 40 collectors	20kWpk(e)	actively cooled
P. 118		10 "heliostats" @ 61.55 m^2 aperture area	64kWpk(e) +400kWp (th)	
P. 119		20 subsystems @ 131.7m^2 aperture	200kWpk(e)	passively cooled
P. 120		36 arrays @ 272 cells Total area 910m^2	25kWpk(e)	Martin Marietta, passively-cooled air

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled (Continued)

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study Operating Plant Study	Plant Size, kW	Assumptions of Advanced State of the Art
P. 131, 138	35616 Ft^2 (Total array)	$292kW_{pk}(e)$	Circular Fresnel concentrator Single crystal silicon
P. 137	1 Ft x 4 Ft (module)	$500kW_{pk}(e)$	Single crystal silicon point focus Fresnel

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled

Parameter: Weight

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P . 116		17960 lb.	$330kW_{pk}(e)$	Collector wt ($36.7kW_{pk}$)
		15970 lb.		Balance of system per turntable
		305360 lb.		Total: (9 turntables)
P. 130	10.6 lbs/ft^2 aperture installed		25 $kW_{pk}(e)$	2636 ft^2 aperture area. Linear Fresnel Concentrator
P. 133	11025 lb. installed		4.5 $kW_{pk}(e)$	Parabolic trough with thermal energy recovery. Carousel tracking. 506ft^2.

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled

Parameter: Life-Time

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 115	20 years		25kW (e)	(Design)
P. 116	20 years	2 years (demonstration)	140kW (th)	
P. 128	20 years		150 kW_{pk}(e)	Single crystal silicon. PV. Reflector augmented flat plate array
	20 years		25 kW_{pk}(e)	Assumed lifetime CR=25. Single crystal silicon cells. Linear Fresnel Concentrator
P. 137		20-30 years		Based on prototype module Testing experience and projected improvements

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled

Parameter: Acquisition Cost (1980 dollars)

Energy Conversion System Ref.	Parameter Value: Study Goal	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 7	\$0.50-\$1.30/Wp		Central station application	System Cost
	\$0.10-\$0.40/Wp			Array only
	\$1.50-\$2.50/Wp			Oil conservation baseline technology (system cost)
P. 10	\$2.80/Wp		Intermediate	1980 goal
	\$0.70/Wp		Intermediate	1982 goal
	\$0.50/Wp		Intermediate	1986 goal
P. 121		\$34/Wp	162kWpk(e) 1020kWpk(th)	
P. 130	\$30.15/ft^2		25 kW_{pk}(e)	Linear Fresnel Concentrator Assumed installed array cost at 4.9 x 10^5ft^2/yr production
P. 133	6500-7000 \$/kW_{pk}		4.5 kW_{pk}(e)	Single crystal silicon; parabolic trough; Carousel tracking; low production volume; thermal energy recovery
P. 134	\$39.03/ft^2		26 kW_{pk}(e)	CR=100 ; Carousel Tracking; Point Focusing Fresnel; passive cooling. At 10^5M^2/yr production
P. 131, 137 138	FOB Price (\$/Wp)	9.38 (P.131) 12.06 (P.137) 16.00 (P.138)	60kW_{pk}(e) (P. 131) 85kW_{pk}(e) (P.137-138)	Single crystal silicon N-S horizontal parabolic trough
	FOB Price (\$/Ft^2)	60.9 (P.131)		
	Installation (\$/Ft^2)	64.9 (P.131)		Installation includes site preparation; structures and foundations; module installation; field wiring; & lightning protection.
	Power Conditioning (\$/Wp)	4.97 (P.131)		

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled (continued)

Parameter: Acquisition Cost (1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 131,137 138	Thermal System ($\$/Ft^2$)	10.7 (P.131)		Thermal system provides cooling and thermal energy utilization
	Total Installed Cost ($\$/W_p$)	38.50 (P. 131)		Total installed cost includes buildings, maintenance equip. and engineering
	Total Installed Cost ($\$/Ft^2$)	249.9 (P.131)		
P. 130, 131 137, 138	FOB Price ($/Wp)	11.57 (P.131) (P.137) 24.00 (P.138)	$27kW_{pk}$(e)	Single crystal silicon. N-S tilted linear Fresnel lens
	FOB Price ($\$/Ft^2$)	118.5 (P.131)		
	Installation ($\$/Ft^2$)	46.5 (P.131)		Installation includes site preparation; structures and foundations; module installation; field wiring; and lightning protection
	Power Conditioning ($/Wp)	1.42 (P.131)		
	Thermal System ($\$/Ft^2$)	22.3 (P.131)		Thermal system provides cooling and thermal energy utilization
	Total Installed Cost ($/Wp)	35.44 (P.131)		Total installed cost includes buildings, maintenance equip. and engineering
	Total Installed Cost ($\$/Ft^2$)	363 (P.131)		
P. 131, 137 138	FOB Price ($/Wp)	8.01 (P. 131) 7.27 (P. 137) 31.00 (P. 138)	$110kW_{pk}$(e)	Single crystal silicon.2 axis tracking parabolic troughs
	FOB Price (Ft^2)	63.7 (P. 131)		

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled (continued)

Parameter: Acquisition Cost (1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 131, 137 138	Installation ($/Ft^2)	18.0 (P. 131)		Installation includes site preparation; structures and foundation; module installation; field wiring; and lightning protection.
	Power Conditioning ($/Wp)	1.96 (P.131)		
	Thermal System ($/Ft^2)	11.2 (P. 131)		Thermal system provides cooling and thermal energy utilization
	Total Installed Cost ($/Wp)	19.71 (P. 131)		Total installed cost includes building, maintenance equip. and engineering
	Total Installed Cost ($/Ft^2)	156.7 (P. 131)		
P. 128, 131 138	FOB Price ($/Wp)	9.00 (P.131) 24.00 (P. 138)	$47kW_{pk}$(e)	Single crystal silicon. N-S horizontal parabolic trough
	FOB Price ($/Ft^2)	62.9 (P. 131)		
	Installation ($/Ft^2)	36.3 (P.131)		Installation includes site preparation; structures and foundation; module installation; field wiring; and lightning protection
	Power Conditioning ($/Wp)	3.13 (P.131)		
	Thermal System ($/Ft^2)	19.3 (P.131)		Thermal sytem provides cooling and thermal energy utilization
	Total Installed Cost ($/Wp)	30.53 (P. 131)		Total installed cost includes building, maintenance equip. and engineering
	Total Installed Cost ($/Ft^2)	213.4 (P. 131)		
P. 128, 131 138	FOB Price ($/Wp)	11.39 (P. 131) 17.00 (P. 138)	$150kW_{pk}$(e) @ 113°F	Polycrystalline silicon. Reflector augmented flat plate

DATA SHEET

Energy Conversion System: Photovoltaic- Actively Cooled

Parameter: Aquisition Cost (Continued)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 158	$2.89/ft^2$			Cost estimate for 1 M^2, 10% efficient.
	$0.31/Wpk			Luminescent concentrator. Assumes $1000/$M^2$ solar cell process technology.

STUDY

P. 177	D.O.E. component cost gals for 1982 of concentrator array at $2.83/Wpk	Cost ($/$ft^2$) of aperture area (1980 $)
	Solar Cells-silicon CZ water. 16% efficiency at 122°F, $330/$ft^2$ cell cost	9.2
	Cell Module-passive heat rejection. Glass encapsulation $132/$ft^2$ module cost	4.0
	Primary Optics - 30 to 40 suns. 80% Optical efficiency	6.6
	Structure and Tracking - Two-Axis tracking. 0.2° tracking accuracy. 26 ft/sec. operational wind speed	9.9
	Factory FOB price	29.7
	Shipping and installation	9.9
	Total installed array costs	39.6

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled (continued)

Parameter: Acquisition Cost (1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 128, 131 138	FOB Price ($/Ft^2)	130.7 (P.131)		
	Installation ($/Ft^2)	39.5 (P. 131)		Installation includes site preparation; structures and foundation; module installation; field wiring; and lightning protection.
	Power Conditioning ($/Wp)	0.77 (P. 131)		
	Thermal System ($/Ft^2)	N.A.		Thermal system provides cooling and thermal energy utilization
	Total Installed Cost ($/Wp)	18.78 (P. 131)		Total installed cost includes buildings, maintenance equip. and engineering
	Total Installed Cost ($/Ft^2)	215.5 (p. 131)		
P. 131, 138	FOB Price ($/Wp)	9.20 (P. 131) 17.00 (P. 138)	292kW(e)	Single crystal silicon. Circular Fresnel concentrator, 2 axis tracking
	FOB Price (Ft^2)	75.5 (P. 131)		
	Installation ($/Ft^2)	38.6 (P. 131)		Installation includes site preparation; structures and foundation; module installation; field wiring; and lightning protection.
	Power Conditioning ($/Wp)	1.83 (P. 131)		
	Thermal System ($/Ft^2)	N.A.		Thermal system provides cooling and thermal energy utilization
	Total Installed Cost ($/Wp)	20.71 (P.131)		Total installed cost includes buildings, maintenance equip. and engineering
	Total Installed Cost ($/Ft^2)	169.8 (P. 131)		
P. 137	FOB Price ($/Wp)	10.31	500kW$_{pk}$(e)	Point focus Fresnel lens. 2 axis tracking. Single crystal silicon

DATA SHEET

Energy Conversion System: Photovoltaics-Actively Cooled

Parameter: Thermal Energy Available

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
P. 130	140 kW_{th} @ 115°F		27 kW_{pk}(e)	Linear Fresnel Concentrator

PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

Bibliography

PHOTOVOLTAICS

P-1

ACCESSION NO.	80C0039560
REPORT NO.PAGE	CONF-791159 PP. 474-488
TITLE	CENTRAL STATION SOLAR-ELECTRIC ENERGY DEVELOPMENT (SEED)
AUTHORS	CANADA, A.H.
AUTHOR AFF	SOLAR-ELECTRIC SYSTEMS ENGINEER, MAMMOTH LAKES, CA
TITLE(MONO)	PROCEEDINGS OF THE US DOE SEMIANNUAL PROGRAM REVIEW OF PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT, APPLICATIONS AND COMMERCIALIZATION
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AVAILABILITY	DEP. NTIS, PC A23/MF A01.
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ABSTRACT	NONE
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P-2

ACCESSION NO.	80C0039559
REPORT NO.PAGE	CONF-791159 PP. 463-473
TITLE	PERSPECTIVES ON THE UTILITY MARKET FOR PHOTOVOLTAIC SYSTEMS
AUTHORS	LEONARD, S.L.
TITLE(MONO)	PROCEEDINGS OF THE US DOE SEMIANNUAL PROGRAM REVIEW OF PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT, APPLICATIONS AND COMMERCIALIZATION
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DESCRIPTORS	ECONOMICS;ELECTRIC UTILITIES;FOSSIL-FUEL POWER PLANTS;FUEL CONSUMPTION;FUEL OILS;MARKET: Q1;MARKETING RESEARCH;PHOTOVOLTAIC POWER PLANTS: T1;PRICES

P-3

ACCESSION NO.	80C0039558
REPORT NO.PAGE	CONF-791159 PP. 451-462
TITLE	PHOTOVOLTAICS PROGRAM TESTS AND APPLICATIONS SUBPROGRAM DATA ACQUISITION, PROCESSING AND DISSEMINATION
AUTHORS	SOHN, R.L.
AUTHOR AFF	JET PROPULSION LAB., PASADENA, CA
TITLE(MONO)	PROCEEDINGS OF THE US DOE SEMIANNUAL PROGRAM REVIEW OF PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT, APPLICATIONS AND COMMERCIALIZATION
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P-4

ACCESSION NO.	80C0039536
REPORT NO.PAGE	CONF-790845 PP. 37-40

TITLE	REGIONAL SURVEY OF PHOTOVOLTAIC DEVELOPMENT AND UTILIZATION
AUTHORS	MORTENSEN, C.
AUTHOR AFF	BONNEVILLE POWER ADMINISTRATION, PORTLAND, OR
TITLE(MONO)	SOLAR 79 NORTHWEST
EDITOR OR COMP	KING, S. (ED.
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AVAILABILITY	DEP. NTIS, PC A19/MF A01.
CONF TITLE	SOLAR 79 NORTHWEST CONFERENCE
CONF PLACE	SEATTLE, WA, USA
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REPORT NO	CONF-790845--
ABSTRACT	THE PHOTOVOLTAIC SYSTEM, ITS COMPONENTS, THEIR PRICES AND THEIR RELATIONSHIP WITH THE ENVIRONMENT ARE EXPLAINED. TYPICAL PRESENT-DAY, COST-EFFECTIVE APPLICATIONS AND USAGE WITHIN THE REGION ARE PRESENTED. THE SCOPE OF RESEARCH AND THE COMMERCIALIZATION STRATEGY FOR THIS PROMISING ENERGY TECHNOLOGY ARE DESCRIBED. ALSO, THE POTENTIAL FOR SOLAR CELL USAGE IN THE PACIFIC NORTHWEST IS DISCUSSED. AS A CONCLUSION, SOME TASKS TO BE PERFORMED BEFORE THE REGIONAL POTENTIAL IS FULLY KNOWN HAVE BEEN LISTED.
DESCRIPTORS	COMMERCIALIZATION;PHOTOVOLTAIC POWER PLANTS: T2;PHOTOVOLTAIC POWER SUPPLIES: T1;REGIONAL ANALYSIS;REVIEWS: U1.02;USES

P-5

ACCESSION NO.	80C0039405
TITLE(MONO)	PROCEEDINGS OF THE US DOE SEMIANNUAL PROGRAM REVIEW OF PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT, APPLICATIONS AND COMMERCIALIZATION
CORPORATE AUTH	JET PROPULSION LAB., PASADENA, CA (USA)
PAGE NO	540
AVAILABILITY	DEP. NTIS, PC A23/MF A01.
CONTRACT NO	CONTRACT EY-76-S-03-0767
CONF TITLE	US DOE SEMI-ANNUAL PROGRAM REVIEW OF PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT, APPLICATIONS AND COMMERCIALIZATION CONFERENCE
CONF PLACE	PINEHURST, NC, USA
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CATEGORIES	EDB-140501;140600
PRIMARY CAT	EDB-140501
REPORT NO	CONF-791159--
ABSTRACT	ABSTRACTS OF 32 PAPERS, PRIMARILY CONSISTING OF SLIDE REPRODUCTIONS, ARE PRESENTED. SUMMARIES OF PANEL DISCUSSIONS ARE ALSO PRESENTED. THE 32 PAPERS WERE ENTERED INTO THE DATA BASE SEPARATELY.
DESCRIPTORS	CONTRACTS;MEETINGS: U1;PHOTOVOLTAIC CELLS: T1;PHOTOVOLTAIC POWER PLANTS;PHOTOVOLTAIC POWER SUPPLIES;PROCEEDINGS;US DOE

P-6

ACCESSION NO.	79C0136062
REPORT NO.PAGE	CONF-790595 PP. 4.32-4.42
TITLE	CENTRAL POWER STATION OVERVIEW
AUTHORS	JONES, G.J.
AUTHOR AFF	SANDIA LABS., ALBUQUERQUE, NM

TITLE(MONO)	PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
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CONF TITLE	DOE SEMI-ANNUAL REVIEW FOR PHOTOVOLTAICS
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ABSTRACT	NONE
DESCRIPTORS	ELECTRIC UTILITIES;ENERGY STORAGE;PHOTOVOLTAIC POWER PLANTS: T1;TEST FACILITIES: Q1

P-7

ACCESSION NO.	79C0136051
REPORT NO.PAGE	CONF-790595 PP. 3.65-3.74
TITLE	PHOTOVOLTAIC CENTRAL STATION PLAN STATUS
AUTHORS	SIEGEL, B.
AUTHOR AFF	AEROSPACE CORP., EL SEGUNDO, CA
TITLE(MONO)	PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
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CONF TITLE	DOE SEMI-ANNUAL REVIEW FOR PHOTOVOLTAICS
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ABSTRACT	NONE
DESCRIPTORS	MARKETING RESEARCH;PHOTOVOLTAIC POWER PLANTS: T1;PLANNING: C1

P-8

ACCESSION NO.	79U0136037
TITLE	WORLD'S LARGEST SOLAR CELL ELECTRIC POWER STATION ACTIVATED
PUB DESC	PUBLIC UTIL. FORTN., V. 104, NO. 6, PP. 65-66
DATE	13 SEP 1979
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
AUGMENTATION	60 MILES EAST OF SAN DIEGO
ABSTRACT	THE WORLD'S LARGEST SOLAR PHOTOVOLTAIC POWER STATION HAS BEEN OPERATING SINCE MID-AUGUST ON A MOUNTAIN TOP NEAR SAN DIEGO, CALIFORNIA. THE 60-KILOWATT, COMPLETELY AUTOMATIC SYSTEM IS EXPECTED TO AUGMENT A DIESEL-POWERED PLANT ON THE MILITARY BASE BY SUPPLYING 10% OF THE POWER USED. THE MILITARY APPLICATIONS OF PHOTOVOLTAIC SYSTEMS (MAPS) PROGRAM WILL DEMONSTRATE THAT DIRECT CURRENT TO ALTERNATE CURRENT SYSTEMS WITHOUT ENERGY STORAGE CAN BE EFFECTIVE IN BOTH MILITARY AND COMMERCIAL REMOTE INSTALLATIONS. A SPIN-OFF OF THE SPACE PROGRAM, SOLAR ELECTRIC POWER SYSTEMS, ARE EXPECTED TO BECOME COMPETITIVE BY 1986.
DESCRIPTORS	ECONOMICS;ELECTRIC UTILITIES;MILITARY FACILITIES: M1;OPERATION: Q2;PHOTOVOLTAIC POWER PLANTS: M2,Q1;POWER GENERATION;REMOTE AREAS;SOLAR CELLS;SOLAR ENERGY CONVERSION

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ACCESSION NO.	79C0136001
REPORT NO.PAGE	CONF-790595 PP. 3.75-3.81
TITLE	STATUS OF DOE-TD AND A STAND-ALONE APPLICATIONS IMPLEMENTATION PLAN
AUTHORS	DEYO, J.N.
AUTHOR AFF	LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO)	PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO	3.75-3.81
AVAILABILITY	DEP. NTIS, PC A24/MF A01.
CONF TITLE	DOE SEMI-ANNUAL REVIEW FOR PHOTOVOLTAICS
CONF PLACE	GATLINBURG, TN, USA
CONF DATE	16 MAY 1979
DATE	1979
CATEGORIES	EDB-140501;140600
PRIMARY CAT	EDB-140501

REPORT NO CONF-790595--
ABSTRACT NONE
DESCRIPTORS IMPLEMENTATION: U1.U2;MARKETING RESEARCH;PHOTOVOLTAIC POWER PLANTS: T2;PHOTOVOLTAIC POWER SUPPLIES: T1;TECHNOLOGY UTILIZATION;US DOE

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P-10 ACCESSION NO. 79C0135996
REPORT NO.PAGE CONF-790595 PP. 3.27-3.32
TITLE IMPLEMENTATION PLANNING
AUTHORS EASTER, R.
AUTHOR AFF JET PROPULSION LAB., PASADENA, CA
TITLE(MONO) PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO 3.27-3.32
AVAILABILITY DEP. NTIS, PC A24/MF A01.
CONF TITLE DOE SEMI-ANNUAL REVIEW FOR PHOTOVOLTAICS
CONF PLACE GATLINBURG, TN, USA
CONF DATE 10 MAY 1979
DATE 1979
CATEGORIES EDB-140501;140601
PRIMARY CAT EDB-140501
REPORT NO CONF-790595--
ABSTRACT NONE
DESCRIPTORS DEMONSTRATION PROGRAMS;FEASIBILITY STUDIES;IMPLEMENTATION: U1.U2;NATIONAL PROGRAM PLANS;PHOTOVOLTAIC POWER PLANTS: T2;PHOTOVOLTAIC POWER SUPPLIES: T1;PLANNING;TECHNOLOGY UTILIZATION;TESTING

P-11 ACCESSION NO. 79C0135992
REPORT NO.PAGE CONF-790595 PP. 2.53-2.62
TITLE PLANNING AND ANALYSIS FOR DEVELOPMENT AND COMMERCIALIZATION OF PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS (DEMAND AND DECISION ANALYSIS)
AUTHORS TABORS, R.D.
AUTHOR AFF MASSACHUSETTS INST. OF TECH., CAMBRIDGE
TITLE(MONO) PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO 2.53-2.62
AVAILABILITY DEP. NTIS, PC A24/MF A01.
CONF TITLE DOE SEMI-ANNUAL REVIEW FOR PHOTOVOLTAICS
CONF PLACE GATLINBURG, TN, USA
CONF DATE 10 MAY 1979
DATE 1979
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501
REPORT NO CONF-790595--
ABSTRACT NONE
DESCRIPTORS COMMERCIALIZATION;DECISION MAKING;ECONOMICS;MARKET;MARKETING RESEARCH: U1.U2;MATHEMATICAL MODELS;PHOTOVOLTAIC POWER PLANTS: T2;PHOTOVOLTAIC POWER SUPPLIES: T1;PLANNING;RESEARCH PROGRAMS

P-12 ACCESSION NO. 79C0135979
REPORT NO.PAGE CONF-790595 PP. 2.1-2.7
TITLE PHOTOVOLTAIC MISSION ANALYSIS
AUTHORS LEONARD, S.L.
AUTHOR AFF AEROSPACE CORP., EL SEGUNDO, CA
TITLE(MONO) PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO 2.1-2.7
AVAILABILITY DEP. NTIS, PC A24/MF A01.
CONF TITLE DOE SEMI-ANNUAL REVIEW FOR PHOTOVOLTAICS
CONF PLACE GATLINBURG, TN, USA
CONF DATE 10 MAY 1979
DATE 1979
CATEGORIES EDB-140501;140600
PRIMARY CAT EDB-140501
REPORT NO CONF-790595--
ABSTRACT NONE
DESCRIPTORS ECONOMICS;HYBRID SYSTEMS;MARKET;PERFORMANCE;PHOTOVOLTAIC CELLS: T;PHOTOVOLTAIC POWER PLANTS;PHOTOVOLTAIC POWER SUPPLIES;PLANNING;SOLAR THERMAL POWER PLANTS;TECHNOLOGY UTILIZATION

P-13

ACCESSION NO.	79C0135987
TITLE(MONO)	PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
CORPORATE AUTH	JET PROPULSION LAB., PASADENA, CA (USA)
PAGE NO	556
AVAILABILITY	DEP. NTIS, PC A24/MF A01.
CONF TITLE	DOE SEMI-ANNUAL REVIEW FOR PHOTOVOLTAICS
CONF PLACE	GATLINBURG, TN, USA
CONF DATE	16 MAY 1979
DATE	1979
CATEGORIES	EDB-140501;140000
PRIMARY CAT	EDB-140501
REPORT NO	CONF-790595--
ABSTRACT	THIS REPORT OF THE PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW HAS BEEN ASSEMBLED TO PROVIDE THE PARTICIPANTS AND OTHER INTERESTED PARTIES WITH A COMPILATION OF ABSTRACTS OF THE 40 TALKS GIVEN. COPIES OF VISUAL AIDS AND PHOTOGRAPHS USED HAVE BEEN PRINTED IN THE BEST AVAILABLE FORM.
DESCRIPTORS	COMBINED COLLECTORS;CONCENTRATOR SOLAR CELLS;CONTRACTS;DESIGN; ENGINEERING;LEADING ABSTRACT;MEETINGS;PHOTOVOLTAIC CELLS: T2; PHOTOVOLTAIC CONVERSION;PHOTOVOLTAIC POWER PLANTS;PHOTOVOLTAIC POWER SUPPLIES;POWER CONDITIONING CIRCUITS;RESEARCH PROGRAMS: Q1,Q2;SOLAR CELLS;TECHNOLOGY UTILIZATION;TENNESSEE;US DOE: T1

P-14

ACCESSION NO.	79R0129462
TITLE(MONO)	COMMERCIAL APPLICATIONS OF SOLAR TOTAL ENERGY SYSTEMS. VOLUME 3. CONCEPTUAL DESIGNS AND MARKET ANALYSES. FINAL REPORT
EDITOR OR COMP	BOOBAR, M.G.; MCFARLAND, B.L.; NALBANDIAN, S.J.; WILLCOX, W.W.; FRENCH, E.P.; SMITH, K.E.
CORPORATE AUTH	ATOMICS INTERNATIONAL DIV., CANOGA PARK, CA (USA)
PAGE NO	149
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EY-76-C-03-1210
DATE	JUL 1978
CATEGORIES	EDB-140704;299001;290600
PRIMARY CAT	EDB-140704
REPORT NO	AI-DOE--13230(VOL.3)
ABSTRACT	THE OVERALL OBJECTIVE OF THIS PROGRAM WAS TO ASSESS THE FEASIBILITY OF USING SOLAR ENERGY TO PROVIDE A SIGNIFICANT FRACTION OF THE ENERGY NEEDS OF COMMERCIAL BUILDINGS THAT HAVE ENERGY DEMANDS GREATER THAN 200 KWE. THE STES CONCEPT TRADE STUDIES, SENSITIVITY PARAMETERS, PERFORMANCE CHARACTERISTICS, AND SELECTED CONCEPTS ARE DISCUSSED. MARKET PENETRATION RATE ESTIMATES ARE PROVIDED, AND TECHNOLOGY ADVANCEMENTS AND UTILIZATION PLANS ARE DISCUSSED. PHOTOVOLTAIC STES CONFIGURATIONS AND RANKINE CYCLE THERMAL STES SYSTEMS ARE CONSIDERED. (WHK)
DESCRIPTORS	COMMERCIAL BUILDINGS: T2;FEASIBILITY STUDIES: Q1;MARKET; MARKETING RESEARCH;OPTIMIZATION;PERFORMANCE;PHOTOVOLTAIC POWER PLANTS: T4;POWER RANGE 1-10 MW;POWER RANGE 100-1000 KW;RANKINE CYCLE POWER SYSTEMS;SIZE;SOLAR ENERGY;SOLAR THERMAL POWER PLANTS: T3;TOTAL ENERGY SYSTEMS: T1,Q2,Q3,Q4

P-15

ACCESSION NO.	79R0129460
TITLE(MONO)	COMMERCIAL APPLICATIONS OF SOLAR TOTAL ENERGY SYSTEMS. VOLUME 1. SUMMARY. FINAL REPORT
EDITOR OR COMP	BOOBAR, M.G.; MCFARLAND, B.L.; NALBANDIAN, S.J.; WILLCOX, W.W.; FRENCH, E.P.; SMITH, K.E.
CORPORATE AUTH	ATOMICS INTERNATIONAL DIV., CANOGA PARK, CA (USA)
PAGE NO	51
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EY-76-C-03-1210
DATE	JUL 1978
CATEGORIES	EDB-140704;299001;290600
PRIMARY CAT	EDB-140704
REPORT NO	AI-DOE--13230(VOL.1)
ABSTRACT	A METHODOLOGY HAS BEEN DEVELOPED BY ATOMICS INTERNATIONAL UNDER CONTRACT TO THE DEPARTMENT OF ENERGY TO DEFINE THE APPLICABILITY OF SOLAR TOTAL ENERGY SYSTEMS (STES) TO THE COMMERCIAL SECTOR (E.G., RETAIL STORES, SHOPPING CENTERS, OFFICES, ETC.) IN THE UNITED STATES. CANDIDATE STES CONCEPTS

	WERE SELECTED TO PROVIDE ON-SITE POWER GENERATION CAPABILITY, AS WELL AS THERMAL ENERGY FOR BOTH HEATING AND COOLING APPLICATIONS. EACH CONCEPT WAS EVALUATED ON THE BASIS OF ITS COST EFFECTIVENESS (I.E., AS COMPARED TO OTHER CONCEPTS) AND ITS ABILITY TO ULTIMATELY PENETRATE AND CAPTURE A SIGNIFICANT SEGMENT OF THIS MARKET, THEREBY RESULTING IN A SAVING OF FOSSIL FUEL RESOURCES. THE PHOTOVOLTAIC STES APPEARS FAVORABLE FOR APPLICATIONS UNDER 600 KWE; WHEREAS THE ORGANIC RANKINE STES WOULD BE MORE COST EFFECTIVE FOR LARGER ENERGY DEMAND APPLICATIONS. INITIAL PENETRATION OF THESE SYSTEMS ARE EXPECTED TO OCCUR IN THE NORTHEAST FOR LARGE SHOPPING CENTERS IN THE 1990 TO 2000 TIME PERIOD. SUCH SYSTEMS COULD PROVIDE ABOUT 0.8 TO 1.6 QUADS (8 X 10$SUP 14$ TO 1.6 X 10$SUP 15$ BTU) OF ENERGY PER YEAR FOR COMMERCIAL APPLICTIONS BY THE YEAR 2010.
DESCRIPTORS	COMMERCIAL BUILDINGS: T1;COMMERCIAL SECTOR;CONTROL SYSTEMS; DEMONSTRATION PROGRAMS;DESIGN;ENERGY DEMAND;ENERGY STORAGE SYSTEMS;EVALUATION;FEASIBILITY STUDIES: Q3;MARKETING RESEARCH; OFFICE BUILDINGS;PHOTOVOLTAIC POWER PLANTS: T4;PHOTOVOLTAIC POWER SUPPLIES;RANKINE CYCLE POWER SYSTEMS;SITE SELECTION;SOLAR AIR CONDITIONING;SOLAR ENERGY;SOLAR SPACE HEATING;SOLAR THERMAL POWER PLANTS: T2;SOLAR WATER HEATING;TOTAL ENERGY SYSTEMS: T3,Q1,Q2,Q4

P-16

ACCESSION NO.	79C0116076
REPORT NO,PAGE	CONF-761191 PP. 2.161-2.162
TITLE	BIBLIOGRAPHY OF MODELING REPORTS ON PHOTOVOLTAIC RESIDENTIAL AND UTILITY SYSTEMS
AUTHORS	TABORS, R.D.
AUTHOR AFF	MASSACHUSETTS INST. OF TECH., CAMBRIDGE
TITLE(MONO)	PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO	2.161-2.162
CONF TITLE	DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW CONFERENCE
CONF PLACE	ARLINGTON, VA, USA
CONF DATE	7 NOV 1976
DATE	1976
CATEGORIES	EDB-140501;140000
PRIMARY CAT	EDB-140501
REPORT NO	CONF-761191--
ABSTRACT	NONE
DESCRIPTORS	BIBLIOGRAPHIES: Q1,Q2;ECONOMIC ANALYSIS;MATHEMATICAL MODELS: Q1,Q2;PHOTOVOLTAIC POWER PLANTS: T1;PHOTOVOLTAIC POWER SUPPLIES: T2;RESIDENTIAL SECTOR;SIMULATION

P-17

ACCESSION NO.	79C0116044
REPORT NO,PAGE	CONF-761191 PP. 1.22-1.91
TITLE	SUMMARY OF SYSTEMS DEFINITION PROJECT ACTIVITIES
AUTHORS	JONES, G.J.; BIRINGER, K.L.
AUTHOR AFF	SANDIA LABS., ALBUQUERQUE, NM
TITLE(MONO)	PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO	1.22-1.91
CONF TITLE	DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW CONFERENCE
CONF PLACE	ARLINGTON, VA, USA
CONF DATE	7 NOV 1976
DATE	1976
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	CONF-761191--
ABSTRACT	THE SYSTEMS DEFINITION PROJECT AND SANDIA LABORATORIES IN SUPPORT OF THE DOE NATIONAL PHOTOVOLTAIC PROGRAM HAS AS ITS

OBJECTIVE TO PROVIDE DESIGN INFORMATION AND SUBSYSTEM REQUIREMENT DEFINITION TO THE OVERALL PROGRAM. THIS INCLUDES APPLICATION ANALYSIS AND CONCEPTUAL DESIGN FOR THE WIDE VARIETY OF SYSTEMS, SYSTEM TRADEOFF STUDIES AND ENGINEERING DESIGN FOR THE MORE PROMISING APPLICATION TYPES, AND THE IDENTIFICATION OF THE TECHNOLOGY STATUS AND REQUIREMENTS FOR MAJOR SUBSYSTEMS AND COMPONENTS.

DESCRIPTORS — AGRICULTURE;COMBINED COLLECTORS;DESIGN;ECONOMIC ANALYSIS: Q2; ECONOMICS;FLAT PLATE COLLECTORS;PHOTOVOLTAIC POWER PLANTS: T2; PHOTOVOLTAIC POWER SUPPLIES: T1;PLANNING: Q2,Q1;RESEARCH PROGRAMS;RESIDENTIAL SECTOR;SOLAR CELLS;SYSTEMS ANALYSIS: Q1; TOTAL ENERGY SYSTEMS

P-18

ACCESSION NO. — 79C0116043
REPORT NO.PAGE — CONF-781191 PP. 1.16-1.21
TITLE — PLANNING AND ANALYSIS FOR DEVELOPMENT OF PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS
AUTHORS — TABORS, R.D.
AUTHOR AFF — MASSACHUSETTS INST. OF TECH., CAMBRIDGE
TITLE(MONO) — PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO — 1.16-1.21
CONF TITLE — DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW CONFERENCE
CONF PLACE — ARLINGTON, VA, USA
CONF DATE — 7 NOV 1978
DATE — 1978
CATEGORIES — EDB-140501
PRIMARY CAT — EDB-140501
REPORT NO — CONF-781191--
ABSTRACT — A DEMAND AND DECISION ANALYSIS FOR RESIDENTIAL AND UTILITY PHOTOVOLTAIC SYSTEMS IS GIVEN. A COMPARISON OF SUN DAY, BOSTON WITH THE NEBRASKA STATE FAIR SHOWED THAT ATTITUDES TOWARD PV WERE NOT SIGNIFICANTLY DIFFERENT IN THE TWO LOCATIONS. DEPLOYMENT STRATEGIES AND STANDARDS AND PERFORMANCE CRITERIA FOR PV ENERGY SYSTEMS ARE DISCUSSED.
DESCRIPTORS — MARKETING RESEARCH;PERFORMANCE;PHOTOVOLTAIC CONVERSION: T1; PHOTOVOLTAIC POWER PLANTS: T2;PLANNING: Q1,Q2;SOCIAL IMPACT; SOCIO-ECONOMIC FACTORS;STANDARDS

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ACCESSION NO. — 79C0116042
REPORT NO.PAGE — CONF-781191 PP. 1.1-1.15
TITLE — PHOTOVOLTAIC MISSION ANALYSIS
AUTHORS — LEONARD, S.L.
AUTHOR AFF — AEROSPACE CORP., EL SEGUNDO, CA
TITLE(MONO) — PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO — 1.1-1.15
CONF TITLE — DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW CONFERENCE
CONF PLACE — ARLINGTON, VA, USA
CONF DATE — 7 NOV 1978
DATE — 1978
CATEGORIES — EDB-140501
PRIMARY CAT — EDB-140501
REPORT NO — CONF-781191--
ABSTRACT — THE RESULTS OF A COMPUTER SIMULATION OF PERFORMANCE AND ECONOMICS OF PHOTOVOLTAIC SYSTEMS IN VARIOUS APPLICATIONS IS PRESENTED. THIS WORK WAS PERFORMED IN SUPPORT OF THE PLANNING, DEVELOPMENT, AND GUIDANCE OF THE NATIONAL PHOTOVOLTAIC PROGRAM. PHOTOVOLTAIC APPLICATIONS LIKELY TO HAVE A MAJOR ENERGY IMPACT IN THE NEAR FUTURE ARE IDENTIFIED AND EVALUATED. STRATEGIES FOR STIMULATING THE GROWTH AND EARLY PENETRATION OF PHOTOVOLTAIC MARKETS ARE DISCUSSED.
DESCRIPTORS — COMPARATIVE EVALUATIONS: Q1;COMPUTER CALCULATIONS;ECONOMIC ANALYSIS: Q2;PHOTOVOLTAIC CONVERSION: T1;PHOTOVOLTAIC POWER PLANTS: T2;RESEARCH PROGRAMS: Q1;SYSTEMS ANALYSIS: Q1;TOTAL ENERGY SYSTEMS;USES

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ACCESSION NO. — 79C0116041
TITLE(MONO) — PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT

		AND APPLICATIONS PROGRAM REVIEW
	CORPORATE AUTH	DAU CORP., BELTSVILLE, MD (USA)
	PAGE NO	543
	AVAILABILITY	DEP. NTIS, PC A23/MF A01.
	CONTRACT NO	CONTRACT NAS-7-100-955604
	CONF TITLE	DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW CONFERENCE
	CONF PLACE	ARLINGTON, VA, USA
	CONF DATE	7 NOV 1978
	DATE	1978
	CATEGORIES	EDB-140501;140600
	PRIMARY CAT	EDB-140501
	REPORT NO	CONF-781191--
	ABSTRACT	THE PROCEEDINGS INCLUDE SUMMARIES OF THIRTY-EIGHT PRESENTATIONS UNDER THE FOLLOWING SECTIONS: OVERVIEW AND PROJECT STATUS REPORTS; STANDARDS PERFORMANCE CRITERIA; COST/ECONOMICS; CONCENTRATOR AND FLAT PANEL TECHNOLOGY ALTERNATIVE FOR 50 CENTS/WATT; BALANCE OF SYSTEM TECHNOLOGY; AND EXPERIENCE GAINED FROM THE DESIGN AND OPERATION OF PHOTOVOLTAIC SYSTEMS.
	DESCRIPTORS	GOVERNMENT POLICIES;LEADING ABSTRACT;MEETINGS: Q1,Q2; PHOTOVOLTAIC CONVERSION: T1;PHOTOVOLTAIC POWER PLANTS: T2; RESEARCH PROGRAMS;REVIEWS: Q1,Q2;TECHNOLOGY ASSESSMENT
P-21	ACCESSION NO.	79C0109974
	TITLE	FEASIBILITY OF CONSTRUCTING A PHOTOELECTRIC UNIT UTILIZING EFFLUENT HEAT
	AUTHORS	BAZAROV, B.A.); BAZAROV, KH.; STREBKOV, D.S.; TAIROV, B.D.; TERESHIN, V.L.
	AUTHOR AFF	PHYSICO-TECHNICAL INST., ASHKHABAD, USS
	TITLE (MONO)	SUN: MANKIND'S FUTURE SOURCE OF ENERGY. VOLUME TWO
	EDITOR OR COMP	DE WINTER F.; COX, M. (EDS.)
	SEC REPT NO	CONF-780114--P2
	PAGE NO	737-742
	CONF TITLE	INTERNATIONAL SOLAR ENERGY CONGRESS
	CONF PLACE	NEW DELHI, INDIA
	CONF DATE	16 JAN 1978
	PUBL LOC	PERGAMON PRESS INC., ELMSFORD, NY
	DATE	1978
	CATEGORIES	EDB-140704;140600
	PRIMARY CAT	EDB-140704
	ABSTRACT	THE EFFICIENCY OF A SOLAR POWER PLANT USING SOLAR CONCENTRATORS, SOLAR CELLS, AND A SOLAR THERMAL POWER CONVERSION SYSTEM IS EXAMINED. THE EVALUATION IS BASED ON THE USE OF FREON-11 WORKING FLUID IN A RANKINE CYCLE. CYCLE PARAMETERS ARE GIVEN; THE CALCULATION PROCEDURE IS DESCRIBED; AND RESULTS ARE PRESENTED AND DISCUSSED. (WHK)
	DESCRIPTORS	COMBINED COLLECTORS;CONCENTRATOR SOLAR CELLS;ECONOMICS; EFFICIENCY: Q3;FEASIBILITY STUDIES: Q1;FREONS;GAS TURBINES; HYBRID SYSTEMS: Q1,Q2,Q3;PHOTOVOLTAIC POWER PLANTS: T2;RANKINE CYCLE;RANKINE CYCLE POWER SYSTEMS;SOLAR CONCENTRATORS;SOLAR POWER PLANTS: T1;SOLAR THERMAL POWER PLANTS: T3;THERMAL EFFICIENCY
P-22	ACCESSION NO.	79C0109941
	TITLE	STATUS OF PHOTOVOLTAIC SYSTEMS AND APPLICATIONS
	AUTHORS	SCHUELLER, D.G.
	AUTHOR AFF	SANDIA LABS., ALBUQUERQUE, NM
	TITLE (MONO)	ENERGY TECHNOLOGY V: CHALLENGES TO TECHNOLOGY
	EDITOR OR COMP	HILL, R.F. (ED.)
	SEC REPT NO	CONF-780222--
	PAGE NO	621-626
	CONF TITLE	5. ENERGY TECHNOLOGY CONFERENCE
	CONF PLACE	WASHINGTON, DC, USA
	CONF DATE	27 FEB 1978
	PUBL LOC	GOVERNMENT INSTITUTES, INC., WASHINGTON, DC
	DATE	1978
	CATEGORIES	EDB-140600;299001
	PRIMARY CAT	EDB-140600
	ABSTRACT	SOLAR PHOTOVOLTAIC CONVERSION SYSTEMS, BASED ON THE DIRECT CONVERSION OF SOLAR ENERGY TO ELECTRICITY THROUGH THE USE OF SOLAR CELLS, HAVE THE POTENTIAL OF PROVIDING A SIGNIFICANT SOURCE OF CLEAN AND RENEWABLE ENERGY IN A VARIETY OF

APPLICATIONS. THE DEPARTMENT OF ENERGY'S PHOTOVOLTAIC CONVERSION PROGRAM IS A MULTIFACETED APPROACH EMPHASIZING THE DEVELOPMENT OF LOW-COST AND RELIABLE PHOTOVOLTAIC SYSTEMS AND THE FIELDING OF APPLICATIONS EXPERIMENTS TO PRODUCE DATA ON THE PERFORMANCE AND RELIABILITY OF SUCH SYSTEMS. THIS PAPER DISCUSSES RESULTS OF SYSTEM CONCEPTUAL DESIGN AND ANALYSIS STUDIES FOR RESIDENTIAL AND CENTRAL GENERATION STATIONS. A NUMBER OF CURRENTLY OPERATING AND PLANNED APPLICATION EXPERIMENTS RANGING IN SIZE FROM A FEW HUNDRED WATTS TO 0.5 MEGAWATTS ARE ALSO REVIEWED.

DESCRIPTORS: EVALUATION: Q1,Q2;PHOTOVOLTAIC CONVERSION: T2;PHOTOVOLTAIC POWER PLANTS: T1;RELIABILITY;REVIEWS;USES

P-23

ACCESSION NO.: 79C0094347
TITLE(MONO): REDOX FLOW CELL ENERGY STORAGE SYSTEMS
EDITOR OR COMP: THALLER, L.H.
CORPORATE AUTH: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO: NASA-TM--79143; CONF-790611--2
PAGE NO: 12
AVAILABILITY: DEP. NTIS, PC A02/MF A01.
CONTRACT NO: CONTRACT EC-76-A-31-1002
CONF TITLE: AIAA TERRESTRIAL ENERGY SYSTEMS CONFERENCE
CONF PLACE: ORLANDO, FL, USA
CONF DATE: 4 JUN 1979
DATE: 1979
CATEGORIES: EDB-300504;200107
PRIMARY CAT: EDB-300504
REPORT NO: DOE/NASA/1002--79/3
ABSTRACT: NASA-REDOX ENERGY STORAGE SYSTEMS ARE BEING DEVELOPED FOR ULTIMATE USE IN STAND-ALONE VILLAGE POWER APPLICATIONS AND DISTRIBUTED ENERGY STORAGE INSTALLATIONS FOR ELECTRIC UTILITY SERVICE. IN THE FORMER APPLICATION, EITHER SOLAR PHOTOVOLTAIC ARRAYS OR WIND TURBINES SUPPLY THE PRIMARY POWER AND AN ELECTROCHEMICAL STORAGE SYSTEM STORES ENERGY DURING TIMES OF EXCESS POWER GENERATION CAPABILITY AND DELIVERS ENERGY DURING TIMES OF INSUFFICIENT POWER GENERATION. VARIOUS ELECTROCHEMICAL AND NON-ELECTROCHEMICAL STORAGE CONCEPTS ARE UNDER CONSIDERATION FOR THESE APPLICATIONS. LIFE CYCLE COSTS, SIMPLICITY OF OPERATION, COMPLEXITY AND STATE OF TECHNOLOGY ARE ALL DETERMINING FACTORS IN SELECTING SYSTEMS FOR THESE IMPORTANT STORAGE APPLICATIONS. NASA--REDOX SYSTEMS ARE ELECTROCHEMICAL STORAGE DEVICES THAT USE TWO FULLY SOLUBLE REDOX COUPLES, ANODE AND CATHODE FLUIDS, AS ACTIVE ELECTRODE MATERIALS SEPARATED BY A HIGHLY SELECTIVE ION EXCHANGE MEMBRANE. THE REACTANTS ARE CONTAINED IN LARGE STORAGE TANKS AND PUMPED THROUGH A STACK OF REDOX FLOW CELLS WHERE THE ELECTROCHEMICAL REACTIONS (REDUCTION AND OXIDATION) TAKE PLACE AT POROUS CARBON FELT ELECTRODES. A STRING OR STACK OF THESE POWER PRODUCING CELLS IS CONNECTED IN SERIES IN A BIPOLAR MANNER. REDOX ENERGY STORAGE SYSTEMS PROMISE TO BE INEXPENSIVE AND POSSESS MANY FEATURES THAT PROVIDE FOR FLEXIBLE DESIGN, LONG LIFE, HIGH RELIABILITY AND MINIMAL OPERATION AND MAINTENANCE COSTS. THESE FEATURES INCLUDE INDEPENDENT SIZING OF POWER AND STORAGE CAPACITY REQUIREMENTS AND INCLUSION WITHIN THE CELL STACK OF A CELL THAT MONITORS THE STATE OF CHARGE OF THE SYSTEM AS A WHOLE, AND A REBALANCE CELL WHICH PERMITS CONTINUOUS CORRECTION TO BE MADE FOR MINOR SIDE REACTIONS THAT WOULD TEND TO RESULT IN THE ANODE FLUID AND CATHODE FLUIDS BECOMING ELECTROCHEMICALLY OUT OF BALANCE.
DESCRIPTORS: CAPACITY;ELECTRIC UTILITIES;ENERGY STORAGE: Q1;ENERGY STORAGE SYSTEMS: T2;OFF-PEAK ENERGY STORAGE;OPERATION;REDOX FUEL CELLS: T1,Q2;REMOTE AREAS;SOLAR CELL ARRAYS;WIND TURBINES

P-24

ACCESSION NO.: 79R0092[illegible]
TITLE(MONO): SOLAR PHOTOVOLTAIC FLAT PANEL APPLICATIONS EXPERIMENT. DRAFT FINAL REPORT, SEPTEMBER 30, 1978--MARCH 31, 1979
EDITOR OR COMP: PRIDEAUX, D.; SPENCER, R.; BRINK, D.; DEHNE, H.
CORPORATE AUTH: ACUREX CORP., MOUNTAIN VIEW, CA (USA); SACRAMENTO MUNICIPAL UTILITY DISTRICT, CA (USA)
PAGE NO: 265
AVAILABILITY: DEP. NTIS, PC A12/MF A01.
CONTRACT NO: CONTRACT AC04-78ET23053
DATE: MAR 1979
CATEGORIES: EDB-140600;140501
PRIMARY CAT: EDB-140600
AUGMENTATION: 100 KWE
REPORT NO: DOE/ET/23053--1
ABSTRACT: THE RESULTS OF PHASE I OF A SOLAR PHOTOVOLTAIC FLAT PANEL APPLICATIONS EXPERIMENT BEING PERFORMED BY ACUREX CORPORATION AND THE SACRAMENTO MUNICIPAL UTILITY DISTRICT (SMUD) ARE DESCRIBED. ACUREX HAS DESIGNED A FLAT PLATE TRACKING ARRAY SYSTEM THAT WILL BE CONSTRUCTED ADJACENT TO THE RANCHO SECO NUCLEAR POWER STATION AND WILL SUPPLY 100 KWE TO THE SMUD POWER GRID. THE SYSTEM USES A NORTH-SOUTH SINGLE AXIS TRACKER AND FULLY TESTED, RELIABLE PHOTOVOLTAIC MODULES. AN INVERTER AND POWER CONDITIONING SYSTEM CONVERTS THE DC PHOTOVOLTAIC OUTPUT

	TO 480 VOLTS 3 PHASE AC COMPATIBLE WITH THE POWER GRID. THE SYSTEM WAS DESIGNED TO FACILITATE FABRICATION OF SUBASSEMBLIES AT THE RANCHO SECO SITE. MOTOROLA WAS SELECTED TO SUPPLY THE PHOTOVOLTAIC CELLS, AND SUPPLIED MODULES FOR ACCEPTANCE TESTING BY THE JET PROPULSION LABORATORY. ONE SECTION OF AN ARRAY WAS FABRICATED AND ERECTED IN THE ACUREX SOLAR TEST PARK TO EVALUATE THE DETAILED DESIGN AND VERIFY ANALYTICAL SIMULATIONS USED IN PERFORMANCE PREDICTIONS. TEST RESULTS ARE INCLUDED. THE PHASE I PLANNING ACTIVITIES FOR PHASE II (CONSTRUCTION) AND PHASE III (OPERATION AND EVALUATION) ARE SUMMARIZED.
DESCRIPTORS	CALIFORNIA;CONTROL SYSTEMS;DESIGN: Q1;DIAGRAMS;ELECTRIC UTILITIES;FABRICATION;INSTALLATION;INTERCONNECTED POWER SYSTEMS; INVERTERS;OPERATION;OPTIMIZATION;PERFORMANCE;PHOTOVOLTAIC POWER PLANTS: M1;PLANNING;POWER CONDITIONING CIRCUITS;POWER RANGE 10-100 KW;SOLAR CELL ARRAYS;SOLAR TRACKING;SYSTEMS ANALYSIS: Q1

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ACCESSION NO.	79R0092813
TITLE (MONO)	ENVIRONMENTAL TESTING OF BLOCK II SOLAR CELL MODULES. LOW-COST SOLAR ARRAY PROJECT
EDITOR OR COMP	GRIFFITH, J.S.
CORPORATE AUTH	JET PROPULSION LAB., PASADENA, CA (USA)
SEC REPT NO	JPL-PUB--79-5
PAGE NO	46
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1012
DATE	1 JAN 1979
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	DOE/JPL/1012--79/1
ABSTRACT	THE RESULTS OF ENVIRONMENTAL TESTS OF BLOCK II SOLAR MODULES ARE DESCRIBED. BLOCK II WAS THE SECOND LARGE SCALE PROCUREMENT OF SILICON SOLAR CELL MODULES MADE BY THE JPL LOW-COST SOLAR ARRAY PROJECT WITH DELIVERIES IN 1977 AND EARLY 1978. THE RESULTS OF TESTING SHOWED THAT THE BLOCK II MODULES WERE GREATLY IMPROVED OVER BLOCK I MODULES. IN SEVERAL CASES IT WAS SHOWN THAT DESIGN IMPROVEMENTS WERE NEEDED TO REDUCE ENVIRONMENTAL TEST DEGRADATION. THESE IMPROVEMENTS WERE INCORPORATED DURING THIS PRODUCTION RUN.
DESCRIPTORS	CRACKS;FOG;FREEZING;HUMIDITY;PERFORMANCE TESTING;RAIN;SERVICE LIFE;SILICON SOLAR CELLS: T1;SOLAR CELL ARRAYS: T2;TESTING: Q1,Q2;THERMAL CYCLING;WEATHERING: Q1,Q2;WIND

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ACCESSION NO.	79C0067313
TITLE (MONO)	SELECTED RESULTS FROM THE TECHNOLOGY ASSESSMENT OF SOLAR ENERGY PROGRAM
EDITOR OR COMP	KRUPKA, M.C.; ALTSEIMER, J.H.
CORPORATE AUTH	LOS ALAMOS SCIENTIFIC LAB., NM (USA)
SEC REPT NO	CONF-790611--3
PAGE NO	8
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-36
CONF TITLE	AIAA TERRESTRIAL ENERGY SYSTEMS CONFERENCE
CONF PLACE	ORLANDO, FL, USA
CONF DATE	4 JUN 1979
DATE	1979
CATEGORIES	EDB-140501;140400
PRIMARY CAT	EDB-140501
REPORT NO	LA-UR--79-950
ABSTRACT	AN INTERIM STATUS REPORT IS GIVEN ON THE TECHNOLOGY ASSESSMENT OF SOLAR ENERGY (TASE) PROGRAM SPONSORED BY THE OFFICE OF ENVIRONMENT OF THE DEPARTMENT OF ENERGY (DOE). A NUMBER OF EMERGING SOLAR TECHNOLOGIES AND SELECTED APPLICATIONS ARE BEING STUDIED FROM ENVIRONMENTAL, INSTITUTIONAL AND SOCIAL VIEWPOINTS. A BROAD OBJECTIVE IS TO ASSESS THE IMPACTS RESULTING FROM THE LARGE-SCALE DEPLOYMENT OF DECENTRALIZED SOLAR TECHNOLOGIES. INITIAL EMPHASIS HAS BEEN PLACED UPON A TECHNICAL CHARACTERIZATION OF THE TECHNOLOGY AND SUBSEQUENTLY UPON THE DEVELOPMENT OF A REPRESENTATIVE MODEL SYSTEM FOR A GIVEN APPLICATION UPON WHICH AN ENVIRONMENTAL ANALYSIS COULD BE MADE. AS AN EXAMPLE, STUDY RESULTS ARE GIVEN FOR A MODEL PHOTOVOLTAIC SYSTEM FOR RESIDENTIAL USE. THE RESULTS TO DATE EMPHASIZE THE BENIGN NATURE OF THE SYSTEM OPERATIONALLY BUT SUGGEST ENVIRONMENTAL CONCERNS RELATED TO SOLAR CELL MANUFACTURE, ENERGY STORAGE SYSTEMS AND ULTIMATE SYSTEM DISPOSAL. THE ENVIRONMENTAL IMPACTS NOTED FOR THE PHOTOVOLTAIC SYSTEM DESCRIBED HEREIN SHOULD BE CONSIDERED FOR OTHER APPLICATIONS WHERE LARGE-SCALE USAGE OR DEPLOYMENT IS PROJECTED.
DESCRIPTORS	DESIGN;ENVIRONMENTAL IMPACTS: Q2;PHOTOVOLTAIC POWER SUPPLIES: T2;RESIDENTIAL BUILDINGS;SOLAR CELL ARRAYS;SOLAR ENERGY: T1; TECHNOLOGY ASSESSMENT: Q1

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ACCESSION NO.	79C0061100
TITLE	ANALYSIS AND SIMULATION OF THE ENERGY SOURCE OF THE FUTURE; THE SOLAR BREEDER
AUTHORS	WIHL, M.; SCHEININE, A.
AUTHOR AFF	SOLAREX CORP, ROCKVILLE, MD
TITLE(MONO)	IEEE PHOTOVOLTAIC SPECIALIST CONFERENCE
SEC REPT NO	CONF-760619--
PAGE NO	908-910
CONF TITLE	IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	5 JUN 1976
PUBL LOC	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC., NEW YORK, NY
DATE	1976
CATEGORIES	EDB-140501;320300
PRIMARY CAT	EDB-140501
ABSTRACT	THE SOLAR BREEDER IS AN ENERGY SELF SUFFICIENT INDUSTRIAL MANUFACTURING PLANT THAT PRODUCES NET ENERGY IN THE FORM OF SOLAR ELECTRIC PANELS. THE BASIC PRINCIPLES OF THE SOLAR BREEDER SYSTEM HAVE BEEN DERIVED BY EXAMINING ITS TOTAL ENERGY BALANCE. NOT ONLY SO-CALLED DIRECT ENERGIES IN THE FORM OF UTILITY ELECTRICITY HAVE BEEN CONSIDERED BUT ALSO INDIRECT ENERGIES CONSISTING OF ALL ENERGIES EXPENDED IN THE MAKING OF THE MATERIALS AND EQUIPMENT USED IN THE MANUFACTURING PROCESS OF THE BREEDER SYSTEM. TWO PARAMETERS HAVE BEEN IDENTIFIED AS ASSUMING PRIME IMPORTANCE FOR BREEDER OPERATION AND AS SENSITIVE INDICATORS FOR TECHNOLOGY CHANGES. ONE IS THE TIME SINCE THE INITIATION OF THE BREEDER OPERATION AT WHICH THE ENERGY DERIVED FROM THE PANEL OUTPUT BALANCES THE ENERGY BORROWED FROM SOCIETY IN FOSSIL FORM TO CONSTRUCT THE PLANT. AFTER THIS TIME, CALLED THE ENERGY PAYBACK TIME OR BREEDING TIME, THE BREEDER SWINGS INTO THE NET ENERGY MODE. THE SECOND PARAMETER IS USED TO CHARACTERIZE THE PANEL LIFE TIME. THUS, THE BREEDER SYSTEMS APPROACH NOT ONLY HELPS EVALUATE FUTURE SOURCES OF INFINITE AND INEXHAUSTIBLE ENERGIES BUT AT THE SAME TIME PROVIDES VALUABLE INFORMATION ABOUT HOW TO APPROACH THEIR LARGE SCALE REALIZATION.
DESCRIPTORS	ENERGY ANALYSIS: Q2;ENERGY BALANCE;INDUSTRIAL PLANTS: T1; MANUFACTURING;NET ENERGY;PAYBACK PERIOD;SERVICE LIFE;SIMULATION; SOLAR CELL ARRAYS: T2,Q1

P-28

ACCESSION NO.	79C0061156
TITLE	PERFORMANCE DEGRADATION MECHANISMS AND MODES IN TERRESTRIAL PHOTOVOLTAIC ARRAYS AND TECHNOLOGY FOR THEIR DIAGNOSIS
AUTHORS	NOEL, G.T.; SLIEMERS, F.A.; DERRINGER, G.C.; WOOD, V.E.; WILKES, K.E.; GAINES, G.B.; CARMICHAEL, D.C.
AUTHOR AFF	BATTELLE, COLUMBUS LAB, OHIO
TITLE(MONO)	IEEE PHOTOVOLTAIC SPECIALIST CONFERENCE
SEC REPT NO	CONF-760619--
PAGE NO	617-623
CONF TITLE	IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	5 JUN 1976
PUBL LOC	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC., NEW YORK, NY
DATE	1976
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
AUGMENTATION	DOE
ABSTRACT	THE VALIDATION OF A 20-YEAR SERVICE LIFE FOR LOW-COST PHOTOVOLTAIC ARRAYS MUST BE ACCOMPLISHED THROUGH ACCELERATED OR ABBREVIATED LIFE-PREDICTION TESTING. METHODOLOGIES FOR SUCH TESTS HAVE BEEN DEVELOPED. THE IMPLEMENTATION OF THESE

METHODOLOGIES REQUIRES THE IDENTIFICATION, ASSESSMENT, AND EXPERIMENTAL EVALUATION OF DIAGNOSTIC TECHNIQUES AND INSTRUMENTS WHICH MAKE POSSIBLE THE MEASUREMENT OF FAILURE-RELATED DEGRADATIVE PROPERTY CHANGES OVER A SHORT TIME PERIOD WITH SUFFICIENT PRECISION TO ALLOW THE PREDICTION OF LIFE OVER 20 YEARS. A STUDY IS BEING CONDUCTED WHICH ADDRESSES THESE NEEDS. ARRAY FAILURE MODES, RELEVANT MATERIALS PROPERTY CHANGES, AND PRIMARY DEGRADATION MECHANISMS ARE DISCUSSED AS A PREREQUISITE TO IDENTIFYING SUITABLE MEASUREMENT TECHNIQUES AND INSTRUMENTS. SPECIFIED EVALUATION CRITERIA ARE APPLIED TO SELECT THE MOST PROMISING TECHNIQUES AND INSTRUMENTS FOR THIS APPLICATION. SELECTED TECHNIQUES AND THEIR CHARACTERISTICS ARE DESCRIBED. EXPERIMENTAL EVALUATIONS REQUIRED TO ESTABLISH A BASIS FOR SELECTING AMONG TECHNIQUES WITH OVERLAPPING CAPABILITIES ARE IDENTIFIED, AS ARE NEEDS FOR ESTABLISHING THE ADEQUACY, PARTICULARLY WITH RESPECT TO PRECISION, OF THE MORE FULLY DEVELOPED TECHNIQUES FOR THIS APPLICATION AND FOR THE EXPERIMENTAL EVALUATION OF PROMISING DEVELOPMENTAL TECHNIQUES. MEASUREMENT NEEDS NOT SATISFIED BY PRESENTLY AVAILABLE TECHNIQUES/INSTRUMENTS ARE ALSO DISCUSSED AND PLANS FOR EXPERIMENTAL STUDIES, CURRENTLY BEING INITIATED, ARE DESCRIBED.

DESCRIPTORS — EVALUATION;FAILURES;MEASURING INSTRUMENTS;MEASURING METHODS; PERFORMANCE TESTING: Q1;SERVICE LIFE;SOLAR CELL ARRAYS: M1; SYSTEM FAILURE ANALYSIS: Q1

P-29

ACCESSION NO.	79R0060955
TITLE (MONO)	SOLAR THERMAL POWER GENERATION: A BIBLIOGRAPHY WITH ABSTRACTS. QUARTERLY UPDATE, JULY--SEPTEMBER 1978
CORPORATE AUTH	NEW MEXICO UNIV., ALBUQUERQUE (USA). TECHNOLOGY APPLICATION CENTER
PAGE NO	137
AVAILABILITY	UNIV. OF NEW MEXICO, ALBUQUERQUE, NM.
DATE	JAN 1979
CATEGORIES	EDB-140000;170000;320000
PRIMARY CAT	EDB-140000
REPORT NO	TAC-STPG--78-003
ABSTRACT	THIS BIBLIOGRAPHY COVERS THE FOLLOWING: ENERGY OVERVIEWS, SOLAR OVERVIEWS, CONSERVATION, ECONOMICS AND LAW, THERMAL POWER, THERMIONIC AND THERMOELECTRIC, OCEAN, WIND POWER, BIOMASS AND PHOTOCHEMICAL AND LARGE PHOTOVOLTAICS. (MHR)
DESCRIPTORS	BIBLIOGRAPHIES: Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9;BIOMASS: T5; ECONOMICS;ENERGY;ENERGY CONSERVATION: T1;LAWS;OCEAN THERMAL ENERGY CONVERSION: T3;PHOTOELECTROCHEMICAL CELLS: T7; PHOTOVOLTAIC POWER PLANTS: T8;REVIEWS;SOLAR ENERGY;SOLAR THERMAL POWER PLANTS: T2;THERMIONIC CONVERSION: T6; THERMOELECTRIC CONVERSION: T9;WIND POWER: T4

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ACCESSION NO.	79R0077686
TITLE (MONO)	SOLAR ENERGY R AND D PROGRAM OF THE EUROPEAN COMMUNITIES
EDITOR OR COMP	STRUB, A.S.
CORPORATE AUTH	COMMISSION OF THE EUROPEAN COMMUNITIES, BRUSSELS (BELGIUM)
PAGE NO	7
AVAILABILITY	DEP. NTIS (US SALES ONLY), PC A02/MF A01.
DATE	1977
DROP NOT.	PORTIONS OF DOCUMENT ARE ILLEGIBLE
CATEGORIES	EDB-140900;140600;140700;140504;299001
PRIMARY CAT	EDB-140900
REPORT NO	NP--23578
ABSTRACT	THE COMMISSION OF THE EUROPEAN COMMUNITIES CARRIES OUT SOLAR ENERGY R AND D IN ITS OWN RESEARCH ESTABLISHMENTS AND BY LETTING CONTRACTS TO RESEARCH INSTITUTIONS IN ITS MEMBER COUNTRIES. THE PAPER DESCRIBES THIS LATTER PART OF ACTIVITIES, WHICH ARE BASED ON A FOUR YEAR PROGRAM FUNDED WITH 17.5 MILLION EUROPEAN UNITS OF ACCOUNT (APPROX. 20 MILLION DOLLARS). THE PROGRAM COMPRISES SIX SECTORS: (1) DWELLINGS/HABITAT, (2) POWER PLANTS, (3) PHOTOVOLTAIC CONVERSION, (4) PHOTOCHEMISTRY, (5) BIOMASS, AND (6) RADIATION DATA. EMPHASIS IS PLACED ON SECTOR (3), FOLLOWED BY (1) AND (2).
DESCRIPTORS	BIOMASS;EUROPEAN COMMUNITIES: T2;HOUSES;PHOTOCHEMISTRY; PHOTOVOLTAIC POWER PLANTS;RESEARCH PROGRAMS: Q1;SOLAR ENERGY CONVERSION: T1,Q2;SOLAR HEATING SYSTEMS;SOLAR POWER PLANTS

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ACCESSION NO.	79X0077644
TITLE(MONO)	INTEGRAL GLASS ENCAPSULATION FOR SOLAR ARRAYS. QUARTERLY PROGRESS REPORT NO. 9 FOR AUGUST 23--NOVEMBER 22, 1978
EDITOR OR COMP	YOUNGER, P.R.
CORPORATE AUTH	SPIRE CORP., BEDFORD, MA (USA)
PAGE NO	22
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT NAS-7-100-954521
DATE	DEC 1978
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	DOE/JPL/954521--6
ABSTRACT	THIS IS THE NINTH QUARTERLY REPORT UNDER A PROGRAM TO DEVELOP INTEGRAL GLASS ENCAPSULATION FOR SOLAR CELL ARRAYS. THE STATUS OF DEVELOPMENT OF THE TECHNIQUES FOR EMPLOYING ELECTROSTATIC BONDING IN CONJUNCTION WITH TERRESTRIAL SOLAR CELLS IS DESCRIBED. FUNCTIONING SOLAR MODULES HAVE BEEN MADE BY ELECTROSTATIC BONDING (ESB) IN SEVERAL CONFIGURATIONS, INCLUDING ESB TOTAL GLASS ENCAPSULATION, ESB/PVB HYBRID ENCAPSULATION, AND ESB FRONT/ORGANIC BACK SYSTEMS. ALL HAVE SHOWN NO NOTICEABLE DEGRADATION, ELECTRICALLY OR MECHANICALLY, IN ACCELERATED TESTING. THESE TESTS SHOW THAT ELECTROSTATIC BONDING WILL BE FULLY CAPABLE OF MEETING THE SPECIFICATION OF A 20-YEAR LIFETIME IN A COST-EFFECTIVE MANNER.
DESCRIPTORS	BONDING;ELECTROSTATICS;ENCAPSULATION: Q1;GLASS;SERVICE LIFE; SOLAR CELL ARRAYS: T1

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ACCESSION NO.	79A0077630
TITLE(MONO)	DEVELOPMENT OF AN ACCELERATED TEST DESIGN FOR PREDICTING THE SERVICE LIFE OF THE SOLAR ARRAY AT MEAD, NEBRASKA. QUARTERLY REPORT
EDITOR OR COMP	GAINES, G.B.; THOMAS, R.E.; NOEL, G.T.; SHILLIDAY, T.S.; WOOD, V.E.; CARMICHAEL, D.C.
CORPORATE AUTH	BATTELLE COLUMBUS LABS., OH (USA)
PAGE NO	52
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT NAS-7-100-954328
DATE	6 FEB 1979
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	DOE/JPL/954328--11
ABSTRACT	ECONOMIC VIABILITY REQUIRES THAT PHOTOVOLTAIC ARRAYS SHOULD HAVE A SERVICE LIFE OF 20 YEARS OR LONGER. QUALIFICATION AND PERFORMANCE TESTS INDICATE THAT PRESENTLY AVAILABLE PHOTOVOLTAIC MODULES PROVIDE ACCEPTABLE PERFORMANCE AT THE TIME OF INSTALLATION. THIS STUDY IS BEING CONDUCTED AS PART OF A PROGRAM TO DEVELOP AND VALIDATE AN ACCELERATED TEST PLAN THAT CAN BE USED TO PREDICT THE USEFUL SERVICE LIFE OF PRESENT AND FUTURE SOLAR ARRAYS. PREVIOUSLY A METHODOLOGY WAS DEVELOPED FOR DESIGNING AN ACCELERATED TEST PROGRAM INCORPORATING TRADE-OFFS BETWEEN THE COST OF EACH TEST AND ITS VALUE IN REDUCING THE VARIANCE IN THE LIFE PREDICTION FOR THAT ARRAY. THE OBJECTIVE OF THE PRESENT STUDY IS TO APPLY THIS METHODOLOGY TO DEVELOP AN ACCELERATED TEST PLAN TO PREDICT THE SERVICE LIFE OF THE 25-KW PHOTOVOLTAIC ARRAY INSTALLED NEAR MEAD, NEBRASKA. POTENTIAL LONG-TERM DEGRADATION MODES FOR THE TWO TYPES OF MODULES IN THE MEAD ARRAY HAVE BEEN DETERMINED AND JUDGMENTS HAVE BEEN MADE AS TO THOSE ENVIRONMENTAL STRESSES AND COMBINATIONS OF STRESSES WHICH ACCELERATE THE DEGRADATION OF THE POWER OUTPUT. HIERARCHICAL TREES REPRESENTING THE SEVERITY OF EFFECTS OF STRESSES (TEST CONDITIONS) ON ELEVEN INDIVIDUAL DEGRADATION MODES HAVE BEEN CONSTRUCTED AND HAVE BEEN PRUNED OF TESTS JUDGED TO BE NONESSENTIAL. COMPOSITES OF THOSE TREES HAVE BEEN DEVELOPED SO THAT THERE IS NOW ONE PRUNED TREE COVERING EIGHT DEGRADATION MODES, ANOTHER COVERING TWO DEGRADATION MODES, AND A THIRD COVERING ONE DEGRADATION MODE. THESE THREE COMPOSITE TREES FORM THE BASIS FOR SELECTION OF TEST CONDITIONS IN THE FINAL TEST PLAN WHICH IS NOW BEING PREPARED.
DESCRIPTORS	AGING: Q1;FORECASTING;MATERIALS TESTING;NEBRASKA;SERVICE LIFE: Q1;SOLAR CELL ARRAYS: T1;STRESSES;TESTING: Q1

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ACCESSION NO. 79A0077655
TITLE(MONO) PV MODULE PERFORMANCE AT MEAD, NEBRASKA TEST SITE. QUARTERLY REPORT FOR OCTOBER 1, 1978--DECEMBER 31, 1978
EDITOR OR COMP FORMAN, S.E.; THEMELIS, M.P.
CORPORATE AUTH MASSACHUSETTS INST. OF TECH., LEXINGTON (USA). LINCOLN LAB.
PAGE NO 35
AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT EY-76-C-02-4094
DATE 1 APR 1979
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501
REPORT NO COO--4094-40
ABSTRACT THE DEPARTMENT OF ENERGY HAS SET A 20-YEAR LIFETIME GOAL FOR TERRESTRIAL PHOTOVOLTAIC MODULES. MASSACHUSETTS INSTITUTE OF TECHNOLOGY'S LINCOLN LABORATORY, IN ITS CAPACITY AS A PHOTOVOLTAIC FIELD TESTS AND APPLICATIONS CENTER, HAS ESTABLISHED VARIOUS EXPERIMENTAL TEST SITES IN THE UNITED STATES RANGING IN SIZE FROM 0.1 TO 25 KW OF PEAK POWER. THESE SITES SERVE AS TEST BEDS FOR PHOTOVOLTAIC SYSTEM COMPONENTS AND INCLUDE MODULES FROM SEVERAL MANUFACTURERS. THIS REPORT SUMMARIZES THE ACTIVITIES OF THE MATERIALS, PROCESSES AND TESTING LABORATORY OF THE SOLAR PHOTOVOLTAIC PROJECT DURING A THREE-MONTH (10/1/78--12/31/78) PERIOD. PARTICULAR ATTENTION IS GIVEN TO TESTING AND ANALYSIS OF SOLAR MODULES FROM THE MEAD, NEBRASKA SITE, WHICH CONTAINS A 25-KW ARRAY. A TRIP TO THE SITE WAS MADE, WHERE VARIOUS TESTING AND INSPECTION PROCEDURES WERE FOLLOWED, IN ORDER TO ASCERTAIN THE PHYSICAL AND ELECTRICAL DEGRADATION WHICH HAD OCCURRED IN MODULES. IN ADDITION, SEVERAL MODULES WERE REMOVED FOR MORE DETAILED TESTING AND INSPECTION IN THE LABORATORY. THE RESULTS OF BOTH THE FIELD TESTING AND LABORATORY ANALYSES ARE REPORTED HERE.
DESCRIPTORS ELECTRICAL PROPERTIES;INSPECTION;NEBRASKA;PERFORMANCE TESTING: Q1;PHYSICAL PROPERTIES;POWER RANGE 10-100 KW;SERVICE LIFE;SOLAR CELL ARRAYS: T1;THERMAL DEGRADATION: Q1

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ACCESSION NO. 79R0061218
TITLE(MONO) MANUAL FOR THE SOLAR TOTAL ENERGY SYSTEM EVALUATION PROGRAM
EDITOR OR COMP MCFARLAND, B.L.
CORPORATE AUTH ATOMICS INTERNATIONAL DIV., CANOGA PARK, CA (USA)
PAGE NO 155
AVAILABILITY DEP. NTIS, PC A08/MF A01.
CONTRACT NO CONTRACT EY-76-C-04-0789
DATE FEB 1979
CATEGORIES EDB-140704;290800;140600
PRIMARY CAT EDB-140704
REPORT NO SAND--78-7045
ABSTRACT THE MATHEMATICAL MODELS USED BY THE SOLAR TOTAL ENERGY SYSTEM EVALUATION PROGRAM (STESEP) ARE DESCRIBED AND THE WAY THE SYSTEMS WERE SELECTED IS DISCUSSED. THE DATA REQUIREMENTS ARE DEFINED. THE OUTPUT OPTIONS AND PROGRAM LIMITATIONS ARE DESCRIBED, AND SAMPLE PROBLEMS THAT CAN BE USED TO ENSURE PROPER PROGRAM OPERATION ARE DISCUSSED. THE CODE ITSELF IS DESCRIBED SEQUENTIALLY. A DETAILED FLOW DIAGRAM OF THE STESEP CODE AND A GLOSSARY OF THE CODE SYMBOLS ARE GIVEN. (MHR)
DESCRIPTORS COMPARATIVE EVALUATIONS: Q1,Q2;COMPUTER CODES: T3,Q1,Q2; FLOWSHEETS;MANUALS;PHOTOVOLTAIC POWER PLANTS;S CODES: Q3;SOLAR POWER PLANTS: T2,Q1;SOLAR THERMAL POWER PLANTS;TOTAL ENERGY SYSTEMS: T1

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ACCESSION NO. 79R0061264
TITLE(MONO) EVALUATION OF AVAILABLE ENCAPSULATION MATERIALS FOR LOW-COST LONG-LIFE SILICON PHOTOVOLTAIC ARRAYS. FINAL REPORT
EDITOR OR COMP CARMICHAEL, D.C.; GAINES, G.B.; NOEL, G.T.; SLIEMERS, F.A.; NANCE, G.P.; BUNK, A.R.; BROCKWAY, M.C.
CORPORATE AUTH BATTELLE COLUMBUS LABS., OH (USA)
PAGE NO 112
AVAILABILITY DEP. NTIS, PC A06/MF A01.
CONTRACT NO CONTRACT NAS-7-100-954328
DATE 30 JUN 1978
CATEGORIES EDB-140501;360404;360603
PRIMARY CAT EDB-140501
REPORT NO DOE/JPL/954328--2

P-36 NONE

P-37 NONE

ABSTRACT	THREE TYPES OF ENCAPSULATION DESIGNS WERE EVALUATED BASED ON THEIR POTENTIALLY LOW MATERIALS AND PROCESSING COSTS: 1) POLYMERIC COATINGS - TRANSPARENT CONFORMAL COATINGS OVER THE CELLS WITH A STRUCTURAL-SUPPORT SUBSTRATE; 2) POLYMERIC FILM LAMINATION - CELLS LAMINATED BETWEEN TWO FILMS OR SHEETS OF POLYMERIC MATERIALS; AND 3) GLASS-COVERED SYSTEMS - CELLS ADHESIVELY BONDED TO A GLASS COVER (SUPERSTRATE) WITH A POLYMERIC POTTANT AND A GLASS OR OTHER SUBSTRATE MATERIAL. MATERIALS THAT ARE PRESENTLY AVAILABLE WERE INVESTIGATED FOR POSSIBLE USE IN THESE ENCAPSULATION SYSTEMS. RESULTS ARE REPORTED FOR 10 POLYMERIC CONFORMAL COATING MATERIALS, 4 POLYMER POTTANT, AND 11 POLYMERIC FILM AND SHEET MATERIALS. AS CANDIDATES FOR BONDING POLYMERS TO POLYMERS OR CELLS IN THE FABRICATION OF ARRAYS, 16 ADHESIVES WERE SUBJECTED TO SCREENING EVALUATIONS. GLASS MATERIALS THAT WERE STUDIED FOR USE AS COVERS, AND AS SUBSTRATES IN SOME CASES, INCLUDED BOROSILICATE GLASS; SO-CALLED IRON-FREE, OR LOW-IRON-CONTENT GLASS; AND SODA-LIME-FLOAT GLASS. FOUR POLYMER ADHESIVES/POTTANTS FOR USE IN FABRICATING GLASS-COVERED ARRAYS WERE EVALUATED. THE CELLS USED IN THIS STUDY WERE PURCHASED FROM A COMMERCIAL SUPPLIER AND HAVE AN SIO/SUB X/ ANTIREFLECTION (AR) COATING AND A SILK-SCREENED AG METALLIZATION. EVALUATIONS OF THESE MATERIALS ARE REPORTED WHICH INCLUDE LIGHT TRANSMITTANCE MEASUREMENTS, MOISTURE BARRIER PROPERTIES, BOND STRENGTHS, AND PARTICULARLY, THE PERFORMANCE OF ENCAPSULATED CELLS.TO CHARACTERIZE THE PERFORMANCE OF THESE DESIGNS AND ENCAPSULATION MATERIALS, MEASUREMENTS WERE MADE OF AS-MANUFACTURED CELLS, AS-CLEANED CELLS, ENCAPSULATED CELLS, AND ENCAPSULATED CELLS THAT WERE EXPOSED TO DIFFERENT LEVELS OF ULTRAVIOLET RADIATION, HIGH HUMIDITY, AND TEMPERATURE CYCLING. (WHK)
DESCRIPTORS	ADHESIVES: D,T6;ANTIREFLECTION COATINGS: D;CLEANING;COVERINGS: D,T5;ELECTRIC CONTACTS: D;ELECTRICAL PROPERTIES: D; ENCAPSULATION: D,T3,Q1,Q2;EVALUATION;EXPERIMENTAL DATA: D; FILMS: D;GLASS: D;HUMIDITY: D;INFRARED RADIATION: D;LAMELLAE: D; LIGHT TRANSMISSION: D;MATERIALS TESTING: D,Q3,Q4,Q5,Q6,Q7,Q8; OPTICAL PROPERTIES: D;PERFORMANCE TESTING: D;PLASTICS: D,T8; POLYMERS: D,T7;PROTECTIVE COATINGS: D,T4;SERVICE LIFE;SHEETS: D; SILICON SOLAR CELLS: D,T2;SOLAR CELL ARRAYS: D,T1;TABLES: D; THERMAL CYCLING: D;WATERPROOFING;WEATHERING: D,Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8;WEIGHT: D

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ACCESSION NO.	79R0054441
TITLE (MONO)	SPECIFICATION FOR THERMAL CYCLING TEST ON SAMPLE OF NIVR SOLAR ARRAYS
EDITOR OR COMP	SEEBOLDT, J.
CORPORATE AUTH	ROYAL NETHERLANDS AIRCRAFT FACTORIES FOKKER, SCHIPHOL-OOST. SPACE DIV.
PAGE NO	7
AVAILABILITY	NTIS PC A02/MF A01.
DATE	20 DEC 1976
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	N--76-26014
ABSTRACT	THE THERMAL CYCLIC TESTS TO BE CARRIED OUT ON A SAMPLE OF NIVR SOLAR PANEL SUBSTRATE IS SPECIFIED. IN THIS SUBSTRATE A NUMBER OF CONNECTIONS BETWEEN DIFFERENT MATERIAL ARE PRESENT SUCH AS CARBON FIBER TO RESIN, AL ALLOY HONEYCOMB TO CARBON FIBER COMPOSITE FACESHEET, AND U-SHAPED EDGEMEMBER TO HONEYCOMB CORE. THE OBJECTIVE OF THE TEST IS TO DEMONSTRATE THAT THIS SAMPLE CAN SURVIVE 700 THERMAL CYCLES BETWEEN -170 C AND +80 C (REPRESENTATIVE FOR THE SERVICE LIFE OF THE SOLAR ARRAY) WITHOUT DELAMINATION OR OTHER FAILURES.
DESCRIPTORS	FAILURES;HONEYCOMB STRUCTURES;SERVICE LIFE;SOLAR CELL ARRAYS: T1;SUBSTRATES;TESTING;THERMAL CYCLING: Q1

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ACCESSION NO.	79R0054456
TITLE (MONO)	THERMAL AND OTHER TESTS OF PHOTOVOLTAIC MODULES PERFORMED IN NATURAL SUNLIGHT
EDITOR OR COMP	STULTZ, J.W.
CORPORATE AUTH	JET PROPULSION LAB., PASADENA, CA (USA)
SEC REPT NO	JPL--5101-76
PAGE NO	59

AVAILABILITY DEP. NTIS, PC A04/MF A01.
CONTRACT NO CONTRACT EX-76-A-29-1012
DATE 31 JUL 1978
CATEGORIES EDB-140501;141000
PRIMARY CAT EDB-140501
REPORT NO DOE/JPL/1012--78/9
ABSTRACT THE ELECTRICAL POWER OUTPUT OF PHOTOVOLTAIC SOLAR CELL MODULES IS DEPENDENT UPON THE OPERATING TEMPERATURE OF THE CELLS, AND DECREASES AT A RATE OF APPROXIMATELY 0.5% PER $SUP 0$C WITH INCREASING CELL TEMPERATURE. BECAUSE OF THIS TEMPERATURE SENSITIVITY, IT IS IMPORTANT TO UNDERSTAND THE THERMAL CHARACTERISTICS OF MODULES SO THAT MODULES AND THEIR SUPPORTING STRUCTURES CAN BE DESIGNED TO REDUCE CELL TEMPERATURE TO THE EXTENT THAT IT IS COST-EFFECTIVE. AN UNDERSTANDING OF MODULE OPERATING TEMPERATURE CHARACTERISTICS IS ALSO NECESSARY TO ALLOW ACCURATE PREDICTION OF MODULE POWER OUTPUT UNDER FIELD OPERATING CONDITIONS, AND TO ALLOW ACCURATE COMPARISON OF THE FIELD ELECTRICAL PERFORMANCE OF DIFFERENT MODULE DESIGNS. THE ACTIVITY DESCRIBED WAS CONDUCTED THROUGHOUT 1977 AND DURING THE FIRST HALF OF 1978, AS A PART OF THE ENGINEERING AREA OF THE JPL LOW-COST SOLAR ARRAY (LSA) PROJECT. THE BULK OF THE TESTING HAS BEEN THE CHARACTERIZATION OF TWENTY-NINE MODULES ACCORDING TO THEIR NOMINAL OPERATING CELL TEMPERATURE (NOCT) AND THE EFFECT ON NOCT OF CHANGES IN MODULE DESIGN, VARIOUS RESIDENTIAL ROOF MOUNTING CONFIGURATIONS, AND DIRT ACCUMULATION. OTHER TESTS, OFTEN PERFORMED PARALLEL WITH THE NOCT MEASUREMENTS, EVALUTED THE IMPROVEMENT IN ELECTRICAL PERFORMANCE BY COOLING THE MODULES WITH WATER AND BY CHANNELING THE WASTE HEAT INTO A PHASE CHANGE MATERIAL (WAX). ELECTRICAL DEGRADATION RESULTING FROM THE NATURAL MARRIAGE OF PHOTOVOLTAIC AND SOLAR WATER HEATING MODULES WAS ALSO DEMONSTRATED. COST EFFECTIVNESS OF EACH OF THESE TECHNIQUES ARE EVALUATED IN LIGHT OF THE LSA COST GOAL OF $0.50 PER WATT.
DESCRIPTORS COMBINED COLLECTORS: T2;COOLING SYSTEMS;DESIGN;EFFICIENCY; ELECTRICAL PROPERTIES;OPERATION;PERFORMANCE TESTING: Q1,Q2; RESEARCH PROGRAMS;SOLAR CELL ARRAYS: T1;TEMPERATURE DEPENDENCE; TEMPERATURE EFFECTS: Q1;WIND

P-40 99/5/0000001-00000957/ 46
ACCESSION NO. 79C0054434
TITLE(MONO) MOTOR STARTING WITH PV SYSTEMS
EDITOR OR COMP LANDSMAN, E.E.
CORPORATE AUTH MASSACHUSETTS INST. OF TECH., LEXINGTON (USA). LINCOLN LAB.
SEC REPT NO CONF-780619--19
PAGE NO 6
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT EY-76-C-02-4094
CONF TITLE IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
CONF PLACE WASHINGTON, DC, USA
CONF DATE 5 JUN 1978
DATE JUN 1978
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501
AUGMENTATION 10-HP MOTOR/PUMP COMBINATION FOR PHOTOVOLTAIC IRRIGATION DEMONSTRATION
REPORT NO COO--4094-16
ABSTRACT IF PHOTOVOLTAIC POWER SYSTEMS (PVPS) ARE TO HAVE SIGNIFICANT IMPACT, THEY MUST BE ABLE TO ACCOMMODATE AC MOTOR LOADS. IF AN INDUCTION MOTOR IS STARTED AT FULL VOLTAGE, IT NORMALLY DRAWS SEVEN TO NINE TIMES ITS FULL LOAD RATED KVA DURING THE TIME NECESSARY TO ACCELERATE FROM STALL TO FULL SPEED. IN A SMALL POWER GENERATION SYSTEM WHERE THE MOTOR IS THE PREDOMINANT LOAD, THIS STARTING TRANSIENT DETERMINES THE SIZE OF MAJOR SYSTEM COMPONENTS, IN PARTICULAR THE INVERTER. ADDITIONALLY IF THERE IS NO STORAGE TO PROVIDE SYSTEM **STIFFNESS**, THE STARTING TRANSIENT BECOMES A CRUCIAL CONSIDERATION. AN ATTRACTIVE SOLUTION TO THE ABOVE PROBLEMS IS TO UTILIZE A VARIABLE VOLTAGE/FREQUENCY MOTOR STARTING SCHEME. THE MOTOR IS STARTED AT LOW FREQUENCY, AND A CORRESPONDINGLY SCALED VOLTAGE. THE VOLTAGE AND FREQUENCY ARE BOTH SLOWLY INCREASED TO THE NOMINAL RUNNING VALUES. THIS PROCEDURE ALLOWS STARTING THE MOTOR WITH STALL TORQUES COMPARABLE TO THOSE OBTAINED FROM ACROSS-THE-LINE STARTING BUT WITH VIRTUALLY NO INPUT POWER TRANSIENT.

DESCRIPTORS	DESIGN: 02;ELECTRIC CONTROLLERS;ELECTRIC MOTORS: M4;ELECTRONIC CIRCUITS;INVERTERS: M2,01;IRRIGATION: M3;PHOTOVOLTAIC POWER PLANTS: M1;PUMPS: 03;SOLAR CELL ARRAYS;START-UP: 04;TESTING; TORQUE;TRANSIENTS;VOLTAGE REGULATORS

P-41

99/5/0000001-0000095//	49
ACCESSION NO.	79C0054453
TITLE(MONO)	PHOTOVOLTAIC POWER SYSTEM FIELD TESTS
EDITOR OR COMP	POPE, M.D.; MATLIN, R.W.
CORPORATE AUTH	MASSACHUSETTS INST. OF TECH., LEXINGTON (USA). LINCOLN LAB.
SEC REPT NO	CONF-780619--20
PAGE NO	9
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-4094
CONF TITLE	IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	5 JUN 1978
DATE	JUN 1978
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	COO--4094-15
ABSTRACT	THE EXISTING AND PLANNED FIELD TEST SYSTEMS ASSOCIATED WITH MIT/LINCOLN LABORATORY'S PHOTOVOLTAIC FIELD TESTS AND APPLICATIONS PROJECT ARE REVIEWED. THE SYSTEMS DISCUSSED ARE PV AGRICULTURAL TESTING AT MEAD, NEBRASKA, WHICH INCLUDES THE EXISTING 25 KW PEAK SYSTEM AS WELL AS ON-GOING DEVELOPMENT OF VERY SMALL ''MICRO-IRRIGATION'' SYSTEMS CONSUMING LESS THAN 1 KW PEAK; A 1.6 KW SYSTEM INSTALLED AT THE CHICAGO MUSEUM OF SCIENCE AND INDUSTRY; THE LINCOLN PV SYSTEM TEST FACILITY AT LEXINGTON, MASSACHUSETTS; FOUR REAL-TIME ENDURANCE TEST SITES LOCATED IN THE NORTHEAST; THE NATURAL BRIDGES 100 KW PV POWER SYSTEM; AND A 20 KW PV POWER SYSTEM FOR ONE AM RADIO STATION. THE LATTER TWO SYSTEMS ARE PRESENTLY BEING DESIGNED. EXPERIENCE GAINED FROM THESE PROJECTS ARE DISCUSSED IN THE CONTEXTS OF STORAGE, SYSTEM RELIABILITY AND SAFETY, EFFICIENCY IMPLICATIONS, AND COSTS FOR PV STRUCTURAL AND FOUNDATION ELEMENTS.
DESCRIPTORS	DEMONSTRATION PROGRAMS: 01;EFFICIENCY;IRRIGATION;PERFORMANCE TESTING: 01;PHOTOVOLTAIC POWER PLANTS: T1;POWER RANGE 1-10 KW; POWER RANGE 10-100 KW;RADIO EQUIPMENT POWER SUPPLIES; RELIABILITY;SAFETY;SOLAR CELL ARRAYS;TEST FACILITIES

P-42

99/5/0000001-0000095//	50
ACCESSION NO.	79X0047676
TITLE(MONO)	LOW-COST SOLAR ARRAY PROJECT. LSA FIELD TEST ANNUAL REPORT, AUGUST 1977--AUGUST 1978
EDITOR OR COMP	JAFFE, P.
CORPORATE AUTH	JET PROPULSION LAB., PASADENA, CA (USA)
PAGE NO	50
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1012
DATE	15 SEP 1978
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	DOE/JPL/1012--78/12
ABSTRACT	THE JPL LIFE TESTING PROGRAM FOR SOLAR CELL ARRAYS IS DESCRIBED. THE TESTING SITES INCLUDE ONE AT JPL, ONE AT TABLE MOUNTAIN IN THE SAN BERNARDINO MOUNTAINS, ONE IN THE DESERT AT GOLDSTONE NEAR BARSTOW, CALIFORNIA, AND ONE AT THE COAST GUARD FACILITY AT POINT VICENTE ON THE PALOS VERDES PENINSULA. THE TEST STANDS AND DATA ACQUISITION SYSTEMS ARE DESCRIBED, AND TEST RESULTS ARE PRESENTED AND DISCUSSED. (WHK)
DESCRIPTORS	DATA ACQUISITION SYSTEMS;ELECTRICAL PROPERTIES;PERFORMANCE TESTING: Q1;SERVICE LIFE;SOLAR CELL ARRAYS: T1;TEST FACILITIES

P-43

99/5/0000001-0000095//	51
ACCESSION NO.	79R0041502
TITLE(MONO)	SOLAR THERMAL POWER GENERATION: A BIBLIOGRAPHY WITH ABSTRACTS. QUARTERLY UPDATE, OCTOBER--DECEMBER 1977
CORPORATE AUTH	NEW MEXICO UNIV., ALBUQUERQUE (USA). TECHNOLOGY APPLICATION CENTER
PAGE NO	104
AVAILABILITY	UNIV. OF NEW MEXICO, ALBUQUERQUE.
DATE	APR 1978

CATEGORIES EDB-140700;140600;140500;170603;140800;140400;060100
PRIMARY CAT EDB-140700
REPORT NO TAC-STPG--77-004
ABSTRACT A TOTAL OF 495 CITATIONS ARE PRESENTED IN THE FOLLOWING CATEGORIES: ENERGY OVERVIEWS; SOLAR OVERVIEWS; ECONOMICS AND LAW; THERMAL POWER; THERMIONIC/THERMOELECTRIC; OCEAN THERMAL DIFFERENTIAL; WIND POWER CONVERSION; BIOMASS; RESIDENTIAL POWER; AND LARGE SCALE PHOTOVOLTAIC. HYDROGEN PRODUCTION. AND OTHER. AN AUTHOR INDEX AND A PERMUTED TITLE/SUBJECT TERM INDEX ARE INCLUDED. (MHR)
DESCRIPTORS BIBLIOGRAPHIES: Q1.Q2.Q3.Q4.Q5.Q6.Q7.Q8.Q9.Q12;BIOMASS: T5; ECONOMICS;ENERGY CONVERSION: T11;HYDROGEN PRODUCTION: T7;OCEAN THERMAL POWER PLANTS: T3;PHOTOVOLTAIC POWER PLANTS: T6; RESIDENTIAL BUILDINGS;REVIEWS: Q10.Q11;SOLAR ENERGY: T10;SOLAR POWER PLANTS: T1;SOLAR RIGHTS: T12;SOLAR THERMAL POWER PLANTS: T2;THERMIONIC CONVERTERS: T8;THERMOELECTRIC GENERATORS: T9;WIND POWER PLANTS: T4

P-44 99/5/0000001-0000095// 52
ACCESSION NO. 79C0041495
TITLE SOLAR ENERGY: PRESENT AND FUTURE
AUTHORS LOEF, G.O.G.
AUTHOR AFF COLORADO STATE UNIV.. FORT COLLINS
TITLE(MONO) PROCEEDINGS OF THE CONSUMER CONFERENCE ON SOLAR ENERGY DEVELOPMENT
SEC REPT NO CONF-761091--
PAGE NO 9-16
CONF TITLE CONSUMER CONFERENCE ON SOLAR ENERGY DEVELOPMENT
CONF PLACE ALBUQUERQUE, NM, USA
CONF DATE 2 OCT 1976
PUBL LOC NEW MEXICO ENERGY RESOURCES BOARD. ALBUQUERQUE. NM
DATE 1976
CATEGORIES EDB-140000;140700;140901;140500
PRIMARY CAT EDB-140000
ABSTRACT METHODS OF GENERATING ELECTRICITY FROM SOLAR ENERGY ARE REVIEWED. SOLAR HEATING AND COOLING AND THE ECONOMICS THEREOF ARE DISCUSSED. (MHR)
DESCRIPTORS ECONOMICS: Q1.Q2.Q3.Q4;PHOTOVOLTAIC POWER PLANTS: T3;REVIEWS; SOLAR AIR CONDITIONING: T2;SOLAR SPACE HEATING: T1;SOLAR THERMAL POWER PLANTS: T4

P-45 99/5/0000001-0000095// 53
ACCESSION NO. 79R0041492
TITLE(MONO) REQUIREMENTS ASSESSMENT OF PHOTOVOLTAIC POWER PLANTS IN ELECTRIC UTILITY SYSTEMS. VOLUME II. TECHNICAL REPORT
EDITOR OR COMP MARSH, W.D.
CORPORATE AUTH GENERAL ELECTRIC CO.. SCHENECTADY. NY (USA). ELECTRIC UTILITY SYSTEMS ENGINEERING DEPT.
PAGE NO 323
AVAILABILITY DEP. NTIS. PC A17/MF A01.
DATE JUN 1978
CATEGORIES EDB-140800;200100
PRIMARY CAT EDB-140800
REPORT NO EPRI-ER--685(VOL.2)
ABSTRACT THIS STUDY DEVELOPED A RATIONAL APPROACH TO THE CONSIDERATION OF SOLAR PHOTOVOLTAIC (PV) POWER PLANTS APPLIED TO ELECTRIC UTILITY SYSTEMS. THEN PERFORMED A REQUIREMENTS ASSESSMENT AND PRELIMINARY IMPACT AND PENETRATION ANALYSES BY STUDYING PV GENERATION IN THREE ACTUAL UTILITY SYSTEMS. CONVENTIONAL UTILITY LOSS-OF-LOAD PROBABILITY AND PRODUCTION SIMULATION METHODS WERE USED. ALONG WITH A PV PLANT PERFORMANCE MODEL DEVELOPED FOR THE STUDY.EVALUATIONS WERE BASED ON COMPARISON OF TOTAL UTILITY GENERATION SYSTEM COSTS WITH AND WITHOUT PV PLANTS. THE STUDY IS REPORTED UNDER THE FOLLOWING SECTIONS: 1) GEOGRAPHIC AREAS FOR PHOTOVOLTAIC POWER PLANTS; 2) SITING OF PHOTOVOLTAIC POWER PLANTS; 3) ELECTRIC UTILITY CHARACTERISTICS; 4) PHOTOVOLTAIC POWER PLANT CHARACTERISTICS; 5) METHODS OF STUDY; 6) STUDY INPUTS; 7) RESULTS; 8) COST AND PERFORMANCE GOALS FOR VIABILITY; 9) REFERENCE PV SELECTION; 10) REFERENCE PV PLANT DEFINITIONS; 11) COMPARISON WITH CONVENTIONAL GENERATION; 12) REQUIREMENTS FOR PV APPLICATIONS; 13) PRELIMINARY IMPACT ANALYSIS; AND 14) PRELIMINARY PENETRATION ANALYSIS. (WHK)
DESCRIPTORS DESIGN;ECONOMIC ANALYSIS: Q1;ECONOMICS;ELECTRIC UTILITIES: T2;

ENERGY STORAGE;ENVIRONMENTAL IMPACTS;FEASIBILITY STUDIES: Q1; PHOTOVOLTAIC POWER PLANTS: T1,Q2;SITE SELECTION;SOLAR CONCENTRATORS

P-46 99/5/0000001-0000095// 54
ACCESSION NO. 79R0041442
TITLE(MONO) REQUIREMENTS DEFINITION AND PRELIMINARY DESIGN OF A PHOTOVOLTAIC CENTRAL STATION TEST FACILITY. TASK 1 TECHNICAL REPORT: FACILITY REQUIREMENTS DEFINITION
EDITOR OR COMP RUZEK, J.B.; STOLTE, W.J.
CORPORATE AUTH BECHTEL NATIONAL, INC., SAN FRANCISCO, CA (USA)
PAGE NO 126
AVAILABILITY DEP. NTIS, PC A07/MF A01.
CONTRACT NO CONTRACT EY-76-C-04-0789
DATE OCT 1976
CATEGORIES EDB-140501;140600
PRIMARY CAT EDB-140501
REPORT NO SAND--76-7043
ABSTRACT TEST FACILITY (CSTF) WOULD BE USED TO TEST VARIOUS PHOTOVOLTAIC ARRAY DESIGNS, SYSTEM CONFIGURATIONS, AND OPERATIONAL MODES. IN ORDER TO DEFINE THE REQUIREMENTS OF THE CSTF, BOTH ELECTRIC UTILITIES AND PHOTOVOLTAIC MANUFACTURERS HAVE BEEN SURVEYED TO DETERMINE THEIR NEEDS. THE MAJOR CRITERIA THAT WILL LEAD TO A CSTF DESIGN TO BEST SATISFY THE NEEDS OF THE ELECTRIC UTILITIES, PHOTOVOLTAIC MANUFACTURERS, AND THE NATIONAL PHOTOVOLTAIC PROGRAM PLAN ARE PRESENTED. (MHR)
DESCRIPTORS CONFIGURATION;CONTROL SYSTEMS;DESIGN;ELECTRIC UTILITIES; MANUFACTURING;OPERATION;PHOTOVOLTAIC POWER PLANTS: T2;PLANNING; RECOMMENDATIONS;SOLAR CELL ARRAYS: T1;TEST FACILITIES: Q1,Q2

P-47 99/5/0000001-0000095// 55
ACCESSION NO. 79R0041417
TITLE(MONO) DIFFUSION OF PHOTOVOLTAICS: BACKGROUND, MODELING, AND INITIAL REACTION OF THE AGRICULTURAL-IRRIGATION SECTOR
EDITOR OR COMP LILIEN, G.L.
CORPORATE AUTH MASSACHUSETTS INST. OF TECH., CAMBRIDGE (USA). ENERGY LAB.
PAGE NO 95
AVAILABILITY DEP. NTIS, PC A05/MF A01.
CONTRACT NO CONTRACT EX-76-A-01-2295-037
DATE MAR 1978
CATEGORIES EDB-140501;140909
PRIMARY CAT EDB-140501
REPORT NO MIT-EL--78-004
ABSTRACT THE BACKGROUND, DEVELOPMENT, AND CALIBRATION OF A MODEL OF INNOVATION-DIFFUSION, DESIGNED TO HELP ALLOCATE GOVERNMENT FIELD TEST AND DEMONSTRATION RESOURCES IN SUPPORT OF A PHOTOVOLTAIC TECHNOLOGY ACROSS SECTORS, REGIONS, AND OVER TIME ARE REVIEWED. CURRENT WORK IN THE AREA OF DIFFUSION AND SUBSTITUTION MODELS, AND A BRIEF REVIEW OF CURRENT THEORY IN THE BUYER BEHAVIOR AREA ARE COVERED. A MODEL IS DEVELOPED, DRAWING UPON CONCEPTS IN THESE AREAS, AND ITS COMPUTER IMPLEMENTATION IS REVIEWED. THE MEASURES NEEDED TO CALIBRATE THE MODEL ARE PERFORMED IN THE AGRICULTURAL-IRRIGATION SECTOR IN CONJUNCTION WITH A FIELD INSTALLATION IN MEAD, NEBRASKA. CONCLUSIONS FROM THE ANALYSIS OF THOSE RESULTS ARE PRESENTED. ADDITIONAL MODEL DEVELOPMENTS AND THE POTENTIAL OF A MODEL-USE TO SUPPORT DECISION-MAKING FOR GOVERNMENT PROGRAMS ARE REVIEWED.
DESCRIPTORS AGRICULTURE;COMMERCIALIZATION;DATA ACQUISITION;DATA ANALYSIS; GOVERNMENT POLICIES;IRRIGATION;MARKET;MATHEMATICAL MODELS; NEBRASKA;ORGANIZATIONAL MODELS;PAYBACK PERIOD;SERVICE LIFE; SOLAR CELL ARRAYS: T1;TECHNOLOGY TRANSFER: Q1

P-48 99/5/0000001-0000095// 56
ACCESSION NO. 79R0034911
TITLE(MONO) BLOCK IV SOLAR CELL MODULE DESIGN AND TEST SPECIFICATION FOR RESIDENTIAL APPLICATIONS
CORPORATE AUTH JET PROPULSION LAB., PASADENA, CA (USA)
PAGE NO 32
AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT EX-76-A-29-1012
DATE 1 NOV 1978
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501

REPORT NO	DOE/JPL/1012—78/14
ABSTRACT	THIS SPECIFICATION PROVIDES NEAR-TERM DESIGN, QUALIFICATION AND ACCEPTANCE REQUIREMENTS FOR TERRESTRIAL SOLAR CELL MODULES SUITABLE FOR INCORPORATION IN PHOTOVOLTAIC POWER SOURCES (2 KW TO 10 KW) APPLIED TO SINGLE FAMILY RESIDENTIAL INSTALLATIONS. REQUIREMENT LEVELS AND RECOMMENDED DESIGN LIMITS FOR SELECTED PERFORMANCE CRITERIA HAVE BEEN SPECIFIED FOR MODULES INTENDED PRINCIPALLY FOR ROOFTOP INSTALLATIONS. MODULES SATISFYING THE REQUIREMENTS OF THIS SPECIFICATION FALL INTO ONE OF TWO CATEGORIES, RESIDENTIAL PANEL OR RESIDENTIAL SHINGLE, BOTH MEETING GENERAL PERFORMANCE REQUIREMENTS PLUS ADDITIONAL CATEGORY PECULIAR CONSTRAINTS.
DESCRIPTORS	DESIGN;ELECTRIC GROUNDS;ELECTRICAL PROPERTIES;HAIL;HUMIDITY; INSPECTION;MECHANICAL TESTS;PERFORMANCE;PERFORMANCE TESTING; POWER RANGE 1-10 KW;RECOMMENDATIONS;RESIDENTIAL BUILDINGS;ROOFS; SERVICE LIFE;SOLAR CELL ARRAYS: T1;SPECIFICATIONS: Q1;THERMAL CYCLING;WEATHERING

P-49	99/5/0000001-0000095//	57
ACCESSION NO.	79R0034976
TITLE (MONO)	ENDURANCE AND SOIL ACCUMULATION TESTING OF PHOTOVOLTAIC MODULES AT VARIOUS MIT/LL TEST SITES
EDITOR OR COMP	FORMAN, S.E.
CORPORATE AUTH	MASSACHUSETTS INST. OF TECH., LEXINGTON (USA). LINCOLN LAB.
PAGE NO	34
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-4094
DATE	28 SEP 1978
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	COO--4094-23
ABSTRACT	A 20-YEAR LIFETIME GOAL WAS SET FOR TERRESTRIAL PHOTOVOLTAIC MODULES. MIT/LL IN ITS CAPACITY AS A PHOTOVOLTAIC FIELD TESTS AND APPLICATIONS CENTER HAS ESTABLISHED VARIOUS EXPERIMENTAL TEST SITES IN THE UNITED STATES RANGING IN SIZE FROM 0.1 TO 25 KW OF PEAK POWER. THESE SITES SERVE AS TEST BEDS FOR PHOTOVOLTAIC SYSTEM COMPONENTS INCLUDING MODULES FROM SEVERAL MANUFACTURERS. MODULE ENDURANCE IN VARIOUS CLIMATES IS CONTINUALLY BEING EVALUATED RELATIVE TO THE 20-YEAR GOAL AND IN ADDITION THE EFFECTS OF SOIL ACCUMULATION ARE BEING MONITORED. DEGRADATION OF PEAK POWER HAS BEEN MEASURED AS A FUNCTION OF TIME AND THE PHYSICAL CHANGES CAUSED BY WEATHERING HAVE BEEN RECORDED. TO DATE, OF 3400 MODULES DEPLOYED AT VARIOUS SITES FOR PERIODS UP TO 16 MONTHS, ONLY 22 HAVE FAILED. THIS LEVEL OF PERFORMANCE FAR EXCEEDS ALL EXPECTATIONS. SITE SPECIFIC ELECTRICAL AND PHYSICAL DEGRADATION AND POWER LOSS DUE TO SOIL ACCUMULATION ARE REPORTED IN THE TEXT FOR FOUR DIFFERENT TYPES OF MODULES.
DESCRIPTORS	CLEANING;CORROSION;DAMAGE;DUSTS;ENERGY LOSSES;FAILURES: Q1; PERFORMANCE: Q1;SERVICE LIFE;SOLAR CELL ARRAYS: T1;TEST FACILITIES;WEATHERING

P-50	99/5/0000001-0000095//	58
ACCESSION NO.	79R0034974
TITLE (MONO)	IRRIGATION SYSTEMS FOR THE SOLAR-PHOTOVOLTAIC ENERGY PROGRAM
EDITOR OR COMP	TVERSKY, M.; FISCHBACH, P.E.
CORPORATE AUTH	MASSACHUSETTS INST. OF TECH., LEXINGTON (USA). LINCOLN LAB.
PAGE NO	55
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-4094
DATE	27 NOV 1978
CATEGORIES	EDB-140501;553000
PRIMARY CAT	EDB-140501
REPORT NO	COO--4094-2
ABSTRACT	THE VIABILITY OF SOLAR PHOTOVOLTAIC (PV) POWER SYSTEMS IS CONSIDERED FOR TWELVE FARM IRRIGATION SYSTEMS IN EIGHT MAJOR IRRIGATION STATES. FOUR OF THE STATES—ARIZONA, CALIFORNIA, NEBRASKA, TEXAS—ARE THE MAJOR U.S. CONSUMERS OF PUMPED AND APPLIED IRRIGATION WATER. PRIMARY ENERGY REQUIREMENTS OF IRRIGATION SYSTEMS SHOW THAT AUTO-SURFACE, GATED PIPE SYSTEMS WITH WATER RE-USE, AND TRICKLE/DRIP SYSTEMS HAVE THE MOST COMPATIBLE LOW-ENERGY REQUIREMENTS TO APPLY WATER WITH PV ARRAYS. PUMPING ENERGY REQUIRED BY PRESENT PV ARRAYS RANGES FROM 0.5 TO 0.7 MILLION BTUS TO LIFT AND APPLY ONE-ACRE-FOOT OF

WATER FROM A STATIC 50-FOOT LIFT BY LOW-LIFT IRRIGATION SYSTEMS. SOLAR-CELL ARRAYS INTEGRATED INTO FARM SYSTEMS CAN BE SUBSTITUTED FOR THE ESCALATING COSTS OF OTHER POWER SOURCES. THE LOW POWER OF PV ARRAYS CAN BE KEYED TO THE ENERGY REQUIREMENTS OF EXTENSIVE AUTOMATION IN IRRIGATION AND CO-LINKED WITH OTHER LOW-ENERGY FARM USES.

DESCRIPTORS ARIZONA;CALIFORNIA;CROPS;ENERGY CONSUMPTION;ENERGY DEMAND: Q1; FARMS;FLORIDA;IRRIGATION: T1;KANSAS;NEBRASKA;NEW MEXICO;OREGON; POWER DEMAND;REGIONAL ANALYSIS;SOLAR CELL ARRAYS: T2,Q1;TEXAS; USES: Q2;WATER RESOURCES

P-51 99/5/0000001-0000095// 59

ACCESSION NO. 79C0024316
TITLE RELIABILITY SIMULATION OF A LARGE SOLAR BATTERY
AUTHORS SUGOMOLKY, A.; GENTSBAKH, I.; SLONIM, M.
AUTHOR AFF BEN GURION UNIV. OF THE NEGEV, BEERSHEBA, ISRAEL
TITLE(MONO) PHOTOVOLTAIC SOLAR ENERGY CONFERENCE
SEC REPT NO CONF-770922--
PAGE NO 1261-1270
CONF TITLE PHOTOVOLTAICS SOLAR ENERGY CONFERENCE
CONF PLACE LUXEMBOURG
CONF DATE 27 SEP 1977
PUBL LOC D. REIDEL PUBLISHING, BOSTON
DATE 1978
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501
ABSTRACT A SOLAR BATTERY (SB) WHICH IS A MATRIX-TYPE COMPLEX OF INDEPENDENTLY FAILING SOLAR CELLS (SC) IS CONSIDERED. THE COMMUTATION SCHEME PROVIDES THAT EACH FAILURE IS EQUIVALENT TO THE ELIMINATION OF THE FAILED SC FROM THE SB. THE RELIABILITY INDEX OF A SB IS ITS EXPECTED OUTPUT POWER (OP) AT A GIVEN OPERATION TIME T, P(T). THE I-V CURVE OF ALL SCS IS ASSUMED TO BE IDENTICAL AND INVARIANT DURING OPERATION. RELIABILITY SIMULATION WAS MADE BY OBTAINING A **BUNDLE** OF P(T)-CURVES. EACH P(T)-TRAJECTORY IS A STEPWISE RANDOM FUNCTION OBTAINED BY MEANS OF A FAILURE TIME GENERATOR AND BY A RANDOM CHOICE OF A FAILED SC. A METHOD FOR RAPID COMPUTATION OF THE OP IS DESCRIBED. A SIMULATION WAS MADE FOR A LARGE SB WITH 10,000 SCS, ASSUMING FAILURE RATE LAMBDA = 10$SUP -6$ HR$SUP -1$, OVER A TIME PERIOD OF 250,000 HR. THE OP BEHAVIOR WAS EXAMINED UNDER DIFFERENT SB STRUCTURES AND FOUND THE BEST TYPE OF STRUCTURES. ALSO, THE INFLUENCE ON THE OP, UNDER A FIXED STRUCTURE, OF THE CHOICE OF THE NOMINAL CURRENT WAS STUDIED. IF SC FAILURES ARE IGNORED, THEN THE BEST CHOICE IS THE CURRENT PROVIDING THE MAXIMAL OP. BUT THIS LEADS TO A VERY UNSTABLE SB WHOSE OP DECREASES DRASTICALLY AFTER A CERTAIN PERCENTAGE OF SCS HAVE FAILED.
DESCRIPTORS CALCULATION METHODS;ELECTRICAL PROPERTIES;FAILURES;RELIABILITY: Q1;SIMULATION;SOLAR CELL ARRAYS: T1

P-52 99/5/0000001-0000095// 60

ACCESSION NO. 79C0024314
TITLE DC MOTOR CHARACTERISTICS FROM SOLAR CELL SUPPLY
AUTHORS APPELBAUM, J.; BANY, J.
AUTHOR AFF TEL-AVIV UNIV., ISRAEL
TITLE(MONO) PHOTOVOLTAIC SOLAR ENERGY CONFERENCE
SEC REPT NO CONF-770922--
PAGE NO 1243-1252
CONF TITLE PHOTOVOLTAICS SOLAR ENERGY CONFERENCE
CONF PLACE LUXEMBOURG
CONF DATE 27 SEP 1977
PUBL LOC D. REIDEL PUBLISHING, BOSTON
DATE 1978
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501
ABSTRACT THE APPLICATIONS OF SOLAR CELLS FOR TERRESTRIAL PURPOSES ARE INCREASING AND THE PERFORMANCE OF KNOWN DEVICES HAVE TO BE RE-ANALYZED SINCE THE SOLAR CELL GENERATOR RESPONDS DIFFERENTLY FROM THAT OF CONVENTIONAL ELECTRICAL ENERGY SOURCES. THE PERFORMANCE OF A SEPARATE EXCITATION, A SERIES AND A SHUNT DC MOTOR SUPPLIED FROM A SOLAR CELL GENERATOR WAS MATHEMATICALLY ANALYZED. THE TORQUE-CURRENT AND TORQUE-SPEED CHARACTERISTICS WERE PLOTTED AS A FUNCTION OF THE IRRADIATION LEVELS. THE MOTOR STARTS AT SOME IRRADIATION LEVEL THAT IS DETERMINED BY THE

	MECHANICAL LOAD, AND THE SPEED VARIES ACCORDING TO THE LOAD CHARACTERISTICS AND THE VARIATION OF THE SOLAR IRRADIATION. THE SOLAR CELL ARRAY WAS CHARACTERIZED BY THE MATHEMATICAL MODEL (I-V RELATION) AND ITS NUMERICAL PARAMETER VALUES. THE SALIENT FEATURES OF THE MOTOR OPERATION ARE: (1) THE OPERATION POINT VARIES WITH THE IRRADIATION AND IS DETERMINED BY THE SOLAR CELL ARRAY, THE LOAD CHARACTERISTICS AND THE MOTOR TYPE. (2) THE SOLAR GENERATOR DOES NOT OPERATE MOST OF THE TIME AT ITS MAXIMUM POWER OUTPUT DURING THE DAY. (3) THE MOTOR PERFORMANCE IS USUALLY INFERIOR TO THAT OF A CONSTANT VOLTAGE SUPPLY.
DESCRIPTORS	DIRECT CURRENT;ELECTRIC MOTORS;ELECTRICAL PROPERTIES; MATHEMATICAL MODELS;OPERATION;PERFORMANCE: Q1;SOLAR CELL ARRAYS: T1

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99/5/0000001-0000095//	61
ACCESSION NO.	79C0024311
TITLE	CALCULATIONS AND IN SITU EXPERIMENTAL DATA ON A WATER PUMPING SYSTEM DIRECTLY CONNECTED TO AN 1/2 K PHOTOVOLTAIC CONVERTORS ARRAY
AUTHORS	ROGER, J.A.; PEREZ, A.; CAMPANA, D.; CASTIEL, A.; DUPUY, C.H.S.
AUTHOR AFF	UNIV., LYON, FRANCE
TITLE(MONO)	PHOTOVOLTAIC SOLAR ENERGY CONFERENCE
SEC REPT NO	CONF-770922--
PAGE NO	1211-1220
CONF TITLE	PHOTOVOLTAICS SOLAR ENERGY CONFERENCE
CONF PLACE	LUXEMBOURG
CONF DATE	27 SEP 1977
PUBL LOC	D. REIDEL PUBLISHING, BOSTON
DATE	1978
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
ABSTRACT	THIS WATER PUMPING SYSTEM, WHICH HAS BEEN WORKING NOW SINCE APRIL 1976 IN CORSICA FOR A SHEEP-FOLD, IS THE FOLLOWING: 56 R.T.C. PANELS FEEDING A DC MOTOR AND CENTRIFUGAL PUMP CHAIN. THE MAIN ORIGINALITY OF THIS PROTOTYPE IS A DIRECT CONNECTION BETWEEN THE PHOTOVOLTAIC SOLAR ARRAY AND THE MOTOR (NO BATTERIES NOR ELECTRONIC CIRCUITS). THE POWER IS OF THE ORDER OF HALF A KW. THE WORKING POINTS OF THE SYSTEM HAVE BEEN RECORDED WITH AN AUTOMATIC REGISTERING STATION WHICH HAS BEEN SET UP ON THE SPOT IN MAY 1977. THE RESULTS SHOW A VERY GOOD AGREEMENT WITH THE SIMULATED CURVES. THIS PROGRAM IS ALSO USED TO SHOW THAT IN MANY CASES A VERY GOOD ADAPTATION BETWEEN THE SOLAR ARRAY AND THE CHAIN (MOTOR, PUMP, WELL) CAN BE OBTAINED. EFFICIENCY CURVES ARE GIVEN. CORRELATION IS ALSO MADE BETWEEN THESE RESULTS AND ANOTHER PROGRAM ON METEOROLOGICAL DATA, AND GIVES A THEORETICAL VALUE OF THE EXPECTED AMOUNT OF PUMPED WATER FOR A GIVEN SITE.
DESCRIPTORS	EFFICIENCY;FRANCE;OPERATION;POWER RANGE 100-1000 W;POWER SUPPLIES: Q1;PUMPS: T1;SIMULATION;SOLAR CELL ARRAYS: T2;USES: Q2;WATER;WELLS

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99/5/0000001-0000095//	62
ACCESSION NO.	79J0024203
TITLE	HAIL RISK MODEL FOR SOLAR COLLECTORS
AUTHORS	GONZALEZ, C.
PUB DESC	PROC. - INST. ENVIRON. SCI., PP. 276-280
DATE	APR 1978
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
ABSTRACT	THIS REPORT PRESENTS THE RESULTS OF A STUDY ASSESSING THE PROBABILITY OF SOLAR ARRAYS BEING STRUCK BY HAILSTONES OF VARIOUS SIZES AS A FUNCTION OF GEOGRAPHIC LOCATION AND SERVICE LIFE. THE STUDY COMPLEMENTS PARALLEL STUDIES OF SOLAR ARRAY SENSITIVITY TO HAIL DAMAGE, THE FINAL OBJECTIVE BEING AN ESTIMATE OF THE MOST COST EFFECTIVE LEVEL FOR SOLAR ARRAY HAIL PROTECTION. A KEY ELEMENT OF THIS STUDY INVOLVES THE GENERATION OF A STATISTICAL MODEL DESCRIBING THE PROBABILITY OF IMPACT BY HAILSTONES OF VARIOUS SIZES AND ESTIMATING THE MEAN TIME BETWEEN HITS.
DESCRIPTORS	DAMAGE: Q1;HAIL;MATHEMATICAL MODELS;PROBABILITY;REGIONAL ANALYSIS;RISK ASSESSMENT;SIZE;SOLAR CELL ARRAYS: T1;WEATHER

P-55

ACCESSION NO. 79X0017970
TITLE(MONO) SOLAR PHOTOVOLTAICS INDUSTRY: THE STATUS AND EVOLUTION OF THE TECHNOLOGY AND THE INSTITUTIONS
EDITOR OR COMP LINDEN, L.H.; BOTTARO, D.; MUSKOWITZ, J.; OCASIO, W.
CORPORATE AUTH MASSACHUSETTS INST. OF TECH., CAMBRIDGE (USA). ENERGY LAB.
PAGE NO 132
AVAILABILITY DEP. NTIS, PC A07/MF A01.
CONTRACT NO CONTRACT EX-76-A-01-2295-037
DATE DEC 1977
CATEGORIES EDB-140501;140600
PRIMARY CAT EDB-140501
REPORT NO MIT-EL--77-021
ABSTRACT A SUMMARY OF PHOTOVOLTAIC OPERATION, PRESENT PROCESS TECHNOLOGY, AND FUTURE OPTIONS IS PRESENTED. A BRIEF HISTORY OF THE PHOTOVOLTAIC INDUSTRY AND ITS EVOLUTION TO THE PRESENT IS INCLUDED AND THE PRESENT AND POSSIBLE FUTURE PARTICIPANTS IN THE PHOTOVOLTAIC INDUSTRY ARE DISCUSSED IN DETAIL. BOTH TECHNOLOGY DEVELOPMENT AND PRODUCTION ACTIVITIES ARE DESCRIBED. A CATEGORIZATION OF FIRMS INVOLVED WITH PHOTOVOLTAIC TECHNOLOGY IS SET FORTH; THE KEY BEHAVIORAL OR TECHNOLOGICAL FEATURES IN COMMON WITH EACH CATEGORY ARE PRESENTED, AS ARE THE DIFFERENCES BETWEEN CATEGORIES. A FRAMEWORK FOR THE DEVELOPMENT OF THE PHOTOVOLTAIC MARKET INCLUDING THE EVOLUTION OF THE PRODUCT AND PROCESS TECHNOLOGY AND THE ASSOCIATED INSTITUTIONAL STRUCTURE IS DEVELOPED. THE WAY DIFFERENT TYPES OF OPPORTUNITIES FOR TECHNOLOGICAL CHANGE MIGHT AFFECT LONG-RUN COST REDUCTION AND INCENTIVES FOR INVESTMENT IN THE PHOTOVOLTAIC INDUSTRY AND IN THE DEVELOPMENT OF NEW TECHNOLOGY IS DESCRIBED. SOME TENTATIVE POLICY IMPLICATIONS DRAWN FROM THE RESEARCH TO DATE ARE PRESENTED. (MHR)
DESCRIPTORS CADMIUM SULFIDE SOLAR CELLS;ECONOMIC ANALYSIS: Q1,Q2;GOVERNMENT POLICIES: Q1,Q2;MANUFACTURING;MARKET: Q1,Q2;PHOTOVOLTAIC CONVERSION;PHOTOVOLTAIC POWER PLANTS;REVIEWS;SILICON SOLAR CELLS;SOLAR CELL ARRAYS: T2;SOLAR INDUSTRY: T1;TECHNOLOGY ASSESSMENT: Q1,Q2

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99/5/0000001-0000095// 64
ACCESSION NO. 79X0017974
TITLE(MONO) DEVELOP SILICONE ENCAPSULATION SYSTEMS FOR TERRESTRIAL SILICON SOLAR ARRAYS. FIRST QUARTERLY PROGRESS REPORT, FEBRUARY 15, 1978--JUNE 30, 1978
CORPORATE AUTH DOW CORNING CORP., MIDLAND, MI (USA)
PAGE NO 49
AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT NAS-7-100-954995
DATE 10 JUL 1978
CATEGORIES EDB-140501;360603
PRIMARY CAT EDB-140501
REPORT NO DOE/JPL/954995--1
ABSTRACT THIS STUDY IS DIRECTED TOWARD THE DEVELOPMENT OF A COST EFFECTIVE ENCAPSULATION SYSTEM FOR PHOTOVOLTAIC MODULES USING SILICONE BASED MATERIALS. THIS IS A COOPERATIVE EFFORT BETWEEN DOW CORNING, THE MAJOR SUPPLIER OF SILICONES AND SILICONE INTERMEDIATES, AND SPECTROLAB A LEADING PHOTOVOLTAIC ARRAY MANUFACTURER. THE TOTAL CONTRACT EFFORT HAS BEEN DIVIDED INTO FOUR TASKS: TECHNOLOGY REVIEW, GENERATION OF SCREENING CONCEPTS, ASSESSMENT OF ENCAPSULATION CONCEPTS, AND EVALUATION OF ENCAPSULATION CONCEPTS. A REVIEW OF TECHNOLOGY PERTINENT TO THE USE AND WEATHERABILITY OF SILICONE BASED MATERIALS AND A PLAN FOR SCREENING ENCAPSULATION CONCEPTS ARE PRESENTED. THE TECHNOLOGY REVIEW COVERED: THE PERFORMANCE OF CLEAR SILICONES IN WEATHERING AND STRESS ENVIRONMENTS, PHOTOVOLTAIC INDUSTRY EXPERIENCE WITH SILICONE MATERIALS USED IN PHOTOVOLTAIC SYSTEMS, AND SILICONES USED IN THE PROTECTION OF ELECTRONIC DEVICES.
DESCRIPTORS ELASTOMERS;ENCAPSULATION: Q2;RESINS;REVIEWS;SEALING MATERIALS; SILICONES: T1;SOLAR CELL ARRAYS: T2;TECHNOLOGY ASSESSMENT; WEATHERING: Q1

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99/5/0000001-0000095// 65
ACCESSION NO. 79X0017974
REPORT NO,PAG. CONF-771051 PP. 33-57
TITLE PHOTOVOLTAIC SYSTEMS DESIGN AND ANALYSIS
AUTHORS MARSHALL, B.W.

AUTHOR AFF SANDIA LABS., ALBUQUERQUE, NM
TITLE(MONO) PROCEEDINGS OF THE PHOTOVOLTAICS PROGRAM SEMI-ANNUAL REVIEW, ADVANCED MATERIALS R AND D BRANCH
PAGE NO 33-57
CONF TITLE ERDA PHOTOVOLTAICS ADVANCED MATERIALS REVIEW MEETING
CONF PLACE DENVER, CO, USA
CONF DATE 4 OCT 1977
DATE 1977
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501
REPORT NO CONF-771051--
ABSTRACT NONE
DESCRIPTORS DESIGN: Q1;ECONOMICS: Q1;PHOTOVOLTAIC CELLS;PHOTOVOLTAIC POWER PLANTS: T1;SOLAR CELLS;SOLAR CONCENTRATORS;SYSTEMS ANALYSIS

P-58 99/5/0000001-0000095// 66
ACCESSION NO. 79C0011164
REPORT NO.PAGE CONF-770865 PP. 133-158
TITLE MIT PHOTOVOLTAICS PROGRAM PROJECT SUMMARY
AUTHORS TABORS, R.D.; WOOD, D.O.; BOTTARO, D.; HARTMAN, R.; LILIEN, G.; LINDEN, L.; NEFF, T.; NUTT-POWELL, T.; SCHWEPPE, F.; WEITZMAN, M.
AUTHOR AFF MASSACHUSETTS INST. OF TECH., CAMBRIDGE
TITLE(MONO) PROCEEDINGS OF THE SEMIANNUAL REVIEW MEETING, SILICON TECHNOLOGY PROGRAMS BRANCH
PAGE NO 133-158
CONF TITLE SEMIANNUAL REVIEW MEETING ON SILICON TECHNOLOGY
CONF PLACE WILLIAMSBURG, VA, USA
CONF DATE 23 AUG 1977
DATE DEC 1977
CATEGORIES EDB-140600;140300;140909;140501
PRIMARY CAT EDB-140600
REPORT NO CONF-770865--
ABSTRACT NONE
DESCRIPTORS AGRICULTURE;COMMERCIALIZATION: Q1,Q2,Q3;DECISION MAKING; GOVERNMENT POLICIES: Q1,Q2,Q3;IRRIGATION;MARKET;NEBRASKA; PHOTOVOLTAIC POWER PLANTS: T3;PUBLIC OPINION;SOLAR CELL ARRAYS: T1;SOLAR WATER PUMPS: T2

P-59 99/5/0000001-0000095// 67
ACCESSION NO. 79C0011161
REPORT NO.PAGE CONF-770865 PP. 99-101
TITLE OPENING COMMENTS FOR THE PANEL DISCUSSION ON IMPACT OF PHOTOVOLTAIC PLANTS IN UTILITY GENERATION SYSTEMS
AUTHORS GOODMAN, F.R. JR.
AUTHOR AFF LOS ANGELES DEPT. OF WATER AND POWER
TITLE(MONO) PROCEEDINGS OF THE SEMIANNUAL REVIEW MEETING, SILICON TECHNOLOGY PROGRAMS BRANCH
PAGE NO 99-101
CONF TITLE SEMIANNUAL REVIEW MEETING ON SILICON TECHNOLOGY
CONF PLACE WILLIAMSBURG, VA, USA
CONF DATE 23 AUG 1977
DATE DEC 1977
CATEGORIES EDB-140600
PRIMARY CAT EDB-140600
REPORT NO CONF-770865--
ABSTRACT NONE
DESCRIPTORS ECONOMIC IMPACT: Q2;ELECTRIC UTILITIES: T1;EVALUATION;LOAD MANAGEMENT: Q1;PHOTOVOLTAIC POWER PLANTS: T2;REVIEWS

P-60 SAME AS P-59

P-61 99/5/0000001-0000095// 69
ACCESSION NO. 79C0011120
REPORT NO.PAGE CONF-770865 PP. 559-579
TITLE PHOTOVOLTAIC ENVIRONMENTAL STUDIES
AUTHORS KUDMANOFF, F.A.
AUTHOR AFF ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, WASHINGTON, DC
TITLE(MONO) PROCEEDINGS OF THE SEMIANNUAL REVIEW MEETING, SILICON TECHNOLOGY PROGRAMS BRANCH
PAGE NO 559-579
CONF TITLE SEMIANNUAL REVIEW MEETING ON SILICON TECHNOLOGY
CONF PLACE WILLIAMSBURG, VA, USA

CONF DATE	23 AUG 1977
DATE	DEC 1977
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	CONF-770865--
ABSTRACT	NONE
DESCRIPTORS	ENVIRONMENTAL IMPACTS: Q1;MATERIALS;RESEARCH PROGRAMS: Q1;SOLAR CELL ARRAYS: T1;TOXICITY

P-62 99/5/0000001-0000095// 70

ACCESSION NO.	79C0011110
REPORT NO.PAGE	CONF-770865 PP. 291-301
TITLE	LOW-COST SILICON ARRAY PROJECT: PRODUCTION PROCESS AND EQUIPMENT STATUS
AUTHORS	BICKLER, D.
AUTHOR AFF	JET PROPULSION LAB., PASADENA, CA
TITLE(MONO)	PROCEEDINGS OF THE SEMIANNUAL REVIEW MEETING, SILICON TECHNOLOGY PROGRAMS BRANCH
PAGE NO	291-301
CONF TITLE	SEMIANNUAL REVIEW MEETING ON SILICON TECHNOLOGY
CONF PLACE	WILLIAMSBURG, VA, USA
CONF DATE	23 AUG 1977
DATE	DEC 1977
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	CONF-770865--
ABSTRACT	NONE
DESCRIPTORS	EQUIPMENT: Q1;MANUFACTURING;ORGANIZATIONAL MODELS;PILOT PLANTS; PRODUCTION: Q1;REVIEWS;SILICON SOLAR CELLS: T1;SOLAR CELL ARRAYS;TECHNOLOGY ASSESSMENT

P-63 99/5/0000001-0000095// 71

ACCESSION NO.	79C0011107
REPORT NO.PAGE	CONF-770865 PP. 259-264
TITLE	LOW-COST SILICON SOLAR ARRAY PROJECT: SILICON MATERIAL STATUS
AUTHORS	LUTWACK, R.
AUTHOR AFF	JET PROPULSION LAB., PASADENA, CA
TITLE(MONO)	PROCEEDINGS OF THE SEMIANNUAL REVIEW MEETING, SILICON TECHNOLOGY PROGRAMS BRANCH
PAGE NO	259-264
CONF TITLE	SEMIANNUAL REVIEW MEETING ON SILICON TECHNOLOGY
CONF PLACE	WILLIAMSBURG, VA, USA
CONF DATE	23 AUG 1977
DATE	DEC 1977
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	CONF-770865--
ABSTRACT	NONE
DESCRIPTORS	EVALUATION;IMPURITIES;MATERIALS TESTING: Q1;ORGANIZATIONAL MODELS;REVIEWS;SILANES;SILICON FLUORIDES;SILICON SOLAR CELLS: T1;SOLAR CELL ARRAYS

P-64 99/5/0000001-0000095// 72

ACCESSION NO.	79J0001163
TITLE	PHOTOVOLTAICS: THE BASICS: AN INTRODUCTION TO SYSTEMS AND SUPPLIERS
AUTHORS	MERCHANT, M.C.
AUTHOR AFF	MCM ENTERPRISES, STANFORD, CA
PUB DESC	SOL. ENG., V. 2, NO. 11, PP. 30-34
DATE	NOV 1977
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
ABSTRACT	THE BASIC PRINCIPLES OF SOLAR CELLS ARE REVIEWED FOR THE LAYMAN. AN INTRODUCTION TO THE USES AND OPERATION OF SOLAR CELL ARRAYS IS PRESENTED. A SOLAR HEATING SYSTEM EMPLOYING PHOTOVOLTAIC CELLS IN A CALIFORNIA CONDOMINIUM BUILDING IS DISCUSSED AS AN EXAMPLE APPLICATION. COMMERCIAL SUPPLIERS OF SOLAR CELL ARRAYS ARE LISTED. FUTURE USE OF SOLAR CELLS IN CONCENTRATING COLLECTOR ARRAYS IS DISCUSSED. (HMC)
DESCRIPTORS	BUILDINGS;CALIFORNIA;COMMERCIALIZATION;CONCENTRATING COLLECTORS; MANUFACTURERS;OPERATION: Q1,Q2;SILICON SOLAR CELLS: T2;SOLAR CELL ARRAYS: T1;SOLAR HEATING SYSTEMS;USES: Q1

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ACCESSION NO.   79X0001137
TITLE(MONO)   ARRAY AUTOMATED ASSEMBLY: PHASE 2. QUARTERLY REPORT FOR PERIOD ENDING MARCH 31, 1978
EDITOR OR COMP   TAYLOR, W.E.; KIMBERLY, W.; MARDESICH, N.; PEPE, A.
CORPORATE AUTH   SPECTROLAB, INC., SYLMAR, CA (USA)
PAGE NO   66
AVAILABILITY   DEP. NTIS, PC A04/MF A01.
CONTRACT NO   CONTRACT NAS-7-100-954853
DATE   MAY 1978
CATEGORIES   EDB-140501;360601
PRIMARY CAT   EDB-140501
REPORT NO   DOE/JPL/954853--2
ABSTRACT   SURFACE TOPOGRAPHY OF TEXTURIZED SOLAR CELLS WAS INVESTIGATED. NO SIGNIFICANT DIFFERENCES WERE FOUND BETWEEN HIGH OUTPUT AND LOW OUTPUT CELLS WITH A COMMON TEXTURIZING TREATMENT. DIFFERENCES WERE FOUND BETWEEN HIGH OUTPUT AND LOW OUTPUT CELLS WITH A COMMON TEXTURIZING TREATMENT. DIFFERENCES WERE FOUND ASSOCIATED WITH VARIATION IN THE DAMAGE REMOVAL ETCH PRIOR TO TEXTURIZING. TITANIA PRECIPITATED GLASSES WERE FOUND TO HAVE SUITABLE PROPERTIES FOR USE AS A DIFFUSION MASKING DIELECTRIC. PRELIMINARY ATTEMPTS TO MAKE SOLAR CELLS WERE NOT SUCCESSFUL. EMULSITONE N-250 PHOSPHOROUS DIFFUSION SOURCE WAS IDENTIFIED TO BE SUITABLE FOR SOLAR CELL FABRICATION, AND A DIFFUSION PROCEDURE WAS IDENTIFIED. A NUMBER OF COMMERCIALLY AVAILABLE FRITTED SILVER PASTES HAVE BEEN IDENTIFIED AS GIVING PROMISING RESULTS. METHODS OF PASTE MODIFICATION BY ADDITIONS OF DONOR SOURCE ADDITIONS AND FRIT CONTENT ADJUSTMENTS WERE FOUND TO BE EFFECTIVE IN PROVING THE PERFORMANCE OF SOME COMMERCIAL PASTES. PRINTED SILVER SOLDER PADS ON ALUMINUM BACK CONTACTS WERE FOUND TO BE SUBJECT TO CORROSIVE FAILURE IN HUMIDITY TESTING. TIN PADS WERE FOUND TO BE FREE OF THIS DEFICIENCY. A MODULE DESIGN COMPRISED OF AN ARRAY OF 10 BY 20 SQUARE CELLS IN AN AREA APPROXIMATELY 2 FEET BY 4 FEET WAS RESOLVED. PROJECTED MODULE EFFICIENCY IS 12.5%. ''LO IRON'' SHEET GLASS FURNISHED BY ASG INDUSTRIES WAS SELECTED FOR THE SUPERSTRATE AS BEING THE MOST COST EFFECTIVE FOR PROJECTED MODULE COSTS BELOW $1.09 PER WATT.
DESCRIPTORS   ADHESIVES;AUTOMATION;COATINGS;DIFFUSION;EFFICIENCY;ELECTRIC CONTACTS;ETCHING;FABRICATION;GLASS;MANUFACTURING: 01;MATERIALS; PRODUCTION;RESEARCH PROGRAMS;SEMICONDUCTOR JUNCTIONS;SILICON SOLAR CELLS: TI;SOLAR CELL ARRAYS;SURFACE FINISHING;SURFACE PROPERTIES;SURFACE TREATMENTS

99/5/0000001-00009577   74

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ACCESSION NO.   79X0001132
TITLE(MONO)   FINAL REPORT ON ACCELERATED/ABBREVIATED TEST METHODS FOR PREDICTING LIFE OF SOLAR CELL ENCAPSULANTS TO JET PROPULSION LABORATORY, CALIFORNIA INSTITUTE OF TECHNOLOGY FOR THE ENCAPSULATION TASK OF THE LOW-COST SOLAR ARRAY PROJECT. PERIOD COVERED: OCTOBER 25, 1977--APRIL 30, 1978
EDITOR OR COMP   KOLYER, J.M.; MANN, N.R.; FARRAR, J.
CORPORATE AUTH   ROCKWELL INTERNATIONAL CORP., ANAHEIM, CA (USA). AUTONETICS STRATEGIC SYSTEMS DIV.
PAGE NO   297
AVAILABILITY   DEP. NTIS, PC A13/MF A01.
CONTRACT NO   CONTRACT NAS-7-100-954458
DATE   30 APR 1978
CATEGORIES   EDB-140501;360405;360404
PRIMARY CAT   EDB-140501
REPORT NO   DOE/JPL/954458--10
ABSTRACT   ACCELERATED AND ABBREVIATED TEST METHODS WERE DEVELOPED FOR PREDICTING THE OUTDOOR LIFETIME OF SOLAR CELL ENCAPSULANTS. ENCAPSULANTS ARE CLEAR MATERIALS APPLIED AS COVERS TO PROTECT THE CELLS FROM ENVIRONMENTAL HAZARDS. AN IMPORTANT PRINCIPLE IS THAT ENCAPSULANTS SHOULD BE TESTED IN A TOTAL ARRAY SYSTEM ALLOWING REALISTIC INTERACTION OF COMPONENTS. THEREFORE, MICROMODULE TEST SPECIMENS WERE FABRICATED WITH A VARIETY OF ENCAPSULANTS, SUBSTRATES, AND TYPES OF CIRCUITRY. INTERACTIONS, SOMETIMES FAVORABLE, WERE OBSERVED BETWEEN THESE COMPONENTS. ONE COMMON FAILURE MODE WAS CORROSION OF CIRCUITRY AND SOLAR CELL METALLIZATION DUE TO MOISTURE PENETRATION. ANOTHER WAS DARKENING AND/OR OPACIFICATION OF ENCAPSULANT. HOWEVER THE POWER OUTPUT REMAINED HIGH DESPITE DRASTIC VISUAL CHANGES. A TEST PROGRAM PLAN WAS PROPOSED. IT INCLUDES MULTICONDITION ACCELERATED EXPOSURE, WHICH WAS DEMONSTRATED TO GIVE SUCCESSFUL

PREDICTIONS FOR PROPERTY CHANGES. ANOTHER METHOD WAS HYPERACCELERATED PHOTOCHEMICAL EXPOSURE USING A SOLAR CONCENTRATOR. IT SIMULATES 20 YEARS OF SUNLIGHT EXPOSURE IN A SHORT TIME PERIOD OF ONE TO TWO WEEKS. THE STUDY WAS BENEFICIAL IN IDENTIFYING SOME COST-EFFECTIVE ENCAPSULANTS AND ARRAY DESIGNS. IT WAS SHOWN THAT SILICON JUNCTIONS ARE REMARKABLY RESISTANT TO MOISTURE AND CONTAMINANTS. WITH CORROSION-RESISTANT CIRCUITRY, THE ENCAPSULANT COULD BE A LOW-COST PLASTIC WHICH PROTECTS CELLS FROM DUST, ABRASION, AND MECHANICAL SHOCK.

DESCRIPTORS — ABRASION;CONCENTRATION RATIO;CONNECTORS;CORROSION;COVERINGS: T2;CRACKING;DEFORMATION;DUSTS;ELECTRICAL PROPERTIES;ELECTRONIC CIRCUITS;ENCAPSULATION;FAILURES;FIELD EFFECT TRANSISTORS;GLASS;IMPACT SHOCK;LIGHT TRANSMISSION;MATHEMATICAL MODELS;MOISTURE;NITROCELLULOSE;OPTICAL PROPERTIES;PERFORMANCE TESTING;PHYSICAL PROPERTIES;PLASTICS: T3;POLYACRYLATES;POLYSTYRENE;POLYURETHANES;SERVICE LIFE: Q1,Q2,Q3;SOLAR CELL ARRAYS;SOLAR CELLS: T1;SOLAR FLUX;TEMPERATURE EFFECTS;TENSILE PROPERTIES;TESTING;THERMAL CYCLING;THERMAL DEGRADATION;ULTRAVIOLET RADIATION;WEATHERING: Q1,Q2,Q3

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99/5/0000001-0000095// 75

ACCESSION NO.	79R0001070
TITLE(MONO)	METHODOLOGY FOR IDENTIFYING MATERIALS CONSTRAINTS TO IMPLEMENTATION OF SOLAR ENERGY TECHNOLOGIES
EDITOR OR COMP	LITCHFIELD, J.W.; WATTS, R.L.; GURWELL, W.E.; HARTLEY, J.N.; BLOOMSTER, C.H.
CORPORATE AUTH	BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA (USA)
PAGE NO	91
AVAILABILITY	DEP. NTIS, PC A05/MF A01.
CONTRACT NO	CONTRACT EY-76-C-06-1830
DATE	JUL 1978
CATEGORIES	EDB-140500
PRIMARY CAT	EDB-140500
REPORT NO	PNL--2711
ABSTRACT	A MATERIALS ASSESSMENT METHODOLOGY FOR IDENTIFYING SPECIFIC CRITICAL MATERIAL REQUIREMENTS THAT COULD HINDER THE IMPLEMENTATION OF SOLAR ENERGY HAS BEEN DEVELOPED AND DEMONSTRATED. THE METHODOLOGY INVOLVES AN INITIAL SCREENING PROCESS, FOLLOWED BY A MORE DETAILED MATERIALS ASSESSMENT. THE DETAILED ASSESSMENT CONSIDERS SUCH MATERIALS CONCERNS AND CONSTRAINTS AS: PROCESS AND PRODUCTION CONSTRAINTS, RESERVE AND RESOURCE LIMITATIONS, LACK OF ALTERNATIVE SUPPLY SOURCES, GEOPOLITICAL PROBLEMS, ENVIRONMENTAL AND ENERGY CONCERNS, TIME CONSTRAINTS, AND ECONOMIC CONSTRAINTS. DATA FOR 55 BULK AND 53 RAW MATERIALS ARE CURRENTLY AVAILABLE ON THE DATA BASE. THESE MATERIALS ARE REQUIRED IN THE EXAMPLE PHOTOVOLTAIC SYSTEMS. ONE PHOTOVOLTAIC SYSTEM AND THIRTEEN PHOTOVOLTAIC CELLS, TEN SOLAR HEATING AND COOLING SYSTEMS, AND TWO AGRICULTURAL AND INDUSTRIAL PROCESS HEAT SYSTEMS HAVE BEEN CHARACTERIZED TO DEFINE THEIR ENGINEERING AND BULK MATERIAL REQUIREMENTS.
DESCRIPTORS	ALUMINIUM;ANTIMONY;AVAILABILITY: Q2;CALCULATION METHODS;COMPUTER CODES;COPPER;GALLIUM;MATERIALS: T2,Q1;MINERAL RESOURCES;PRODUCTION;RESOURCES: Q2;SOLAR CELL ARRAYS;SOLAR CELLS;SOLAR ENERGY: T1;TECHNOLOGY ASSESSMENT

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99/5/0000C01-0000095// 76

ACCESSION NO.	76R0127362
TITLE(MONO)	EFFECTS OF ENCAPSULATION ON THE OPTICAL AND THERMAL RESPONSE OF SOLAR CELLS USED IN CONCENTRATED-FLUX SYSTEMS. FINAL REPORT
EDITOR OR COMP	WOOD, V.E.; KENAN, R.P.; GAINES, G.H.
CORPORATE AUTH	BATTELLE COLUMBUS LABS., OH (USA)
PAGE NO	63
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EY-76-C-04-0789
DATE	26 APR 1976
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	SAND--76-7064
ABSTRACT	FOR PHOTOVOLTAIC ARRAYS TO BECOME A PRACTICAL MEANS OF SOLAR-ENERGY CONVERSION ON A LARGE SCALE, IT WILL BE NECESSARY FOR THE ARRAYS TO OPERATE WITH SMALL DEGRADATION IN ELECTRICAL OUTPUT AND WITH A MINIMUM OF REPAIR AND MAINTENANCE FOR 20 YEARS IN ORDER TO RECOVER THE ENERGY EXPENDED IN MANUFACTURING

AND DEPLOYING THE ARRAYS. TO ACCOMPLISH THIS, IT WILL BE NECESSARY TO PROTECT THE SOLAR CELLS AND THE ELECTRICAL LEADS IN THESE ARRAYS FROM DELETERIOUS ENVIRONMENTAL EFFECTS. ONE WAY TO REDUCE DIRECTLY THESE EFFECTS IS TO ENCAPSULATE EACH SOLAR CELL WITH A MATERIAL (OR A STACK OF MATERIALS) WHICH ALLOWS THE INCIDENT SOLAR RADIATION TO REACH THE CELL, BUT WHICH PROTECTS IT FROM THE ATMOSPHERE. ENCAPSULATING THE CELL, HOWEVER, IS BOUND TO AFFECT THE AMOUNT OF SOLAR RADIATION ABSORBED WITHIN THE SEMICONDUCTOR, AND THUS THE CELL'S ELECTRICAL OUTPUT. THE ENCAPSULATION IS LIKELY, AS WELL, TO AFFECT THE THERMAL BALANCE OF THE SYSTEM, AND THUS THE STEADY-STATE OPERATING TEMPERATURE OF THE CELL. THESE EFFECTS ARE PARTICULARLY SIGNIFICANT IN CONCENTRATOR SYSTEMS, WHERE A RELATIVELY LARGE FLUX OF SOLAR ENERGY IS FOCUSED, BY LENSES OR MIRRORS, ONTO A RELATIVELY SMALL NUMBER OF CELLS. THESE CELLS ARE LIKELY TO BE CONSTRUCTED USING A MORE ADVANCED TECHNOLOGY THAN THAT USED IN FLAT-PLATE SYSTEMS, AND IT IS IMPORTANT TO ASSESS QUANTITATIVELY THE CHANGES THAT ENCAPSULATION WILL PRODUCE ON THE OPTICAL AND THERMAL BEHAVIORS. SUCH AN ASSESSMENT IS PRESENTED. THE TECHNIQUES FOR MAKING SUCH AN ASSESSMENT ARE DESCRIBED, AND ARE APPLIED TO A SPECIFIC SYSTEM WITH SEVERAL CANDIDATE ENCAPSULANTS. THE SYSTEM CHOSEN FOR REPRESENTATIVE CALCULATIONS IS OF THE SANDIA TYPE, INVOLVING MOLDED PLASTIC FRESNEL-LENS CONCENTRATORS, LOW-RESISTIVITY N$SUP +$ - P SILICON CELLS, SI$SUB 3$N$SUB 4$ ANTIREFLECTION COATINGS, AND ALUMINUM BASEPLATES PROVIDING A COMMON HEAT SINK FOR EACH 27-CELL ARRAY.

DESCRIPTORS — ANTIREFLECTION COATINGS;CALCULATION METHODS;CONCENTRATION RATIO; CONVECTION;CURRENT DENSITY;DIMENSIONS;ELECTRICAL PROPERTIES; ENCAPSULATION: Q1;FILMS;FRESNEL LENS;MATHEMATICAL MODELS; OPTICAL PROPERTIES;REFLECTIVITY;SERVICE LIFE;SILICON SOLAR CELLS;SOLAR CELL ARRAYS;SOLAR CELLS: T1;SOLAR CONCENTRATORS; STRAINS;TEMPERATURE EFFECTS;THERMAL ANALYSIS;THERMAL DEGRADATION

P-69 99/3/0000001-0000095// 77

ACCESSION NO. — 78R0123659
TITLE(MONO) — SAFETY PROCEDURES FOR THE 25-KW SOLAR PHOTOVOLTAIC ARRAY AT MEAD, NEBRASKA
EDITOR OR COMP — FORMAN, S.E.; LANDSMAN, E.E.
CORPORATE AUTH — MASSACHUSETTS INST. OF TECH., LEXINGTON (USA). LINCOLN LAB.
PAGE NO — 25
AVAILABILITY — DEP. NTIS, PC A02/MF A01.
CONTRACT NO — CONTRACT EY-76-C-02-4094
DATE — 7 APR 1978
CATEGORIES — EDB-140600
PRIMARY CAT — EDB-140600
REPORT NO — COO--4094-7
ABSTRACT — SINCE THE 25-KW SOLAR PHOTOVOLTAIC AGRICULTURAL FIELD TEST SYSTEM AT THE UNIVERSITY OF NEBRASKA IS A UNIQUE ELECTRICAL POWER SYSTEM, SPECIAL SAFETY RULES AND REGULATIONS ARE NEEDED TO GOVERN ITS OPERATION. FIELD INSPECTION AND MAINTENANCE OPERATIONS REQUIRE THE HANDLING OF ELECTRICALLY ACTIVE ELEMENTS DURING DAYLIGHT HOURS. THE METHODS AND TECHNIQUES NECESSARY TO PERFORM THESE OPERATIONS IN A SAFE MANNER AND TO MAKE FIELD PERSONNEL MORE SAFETY CONSCIOUS AS WELL ARE ENUMERATED.
DESCRIPTORS — CLEANING;CONNECTORS;DEMONSTRATION PLANTS;ELECTRONIC CIRCUITS; INSPECTION;MAINTENANCE;NEBRASKA;OPERATION;PHOTOVOLTAIC POWER PLANTS: T1;POWER RANGE 10-100 KW;SAFETY: Q1;TEST FACILITIES

P-70 99/3/0000001-0000095// 78

ACCESSION NO. — 78J0123849
TITLE — PROSPECTS FOR PHOTOVOLTAIC CONVERSION
AUTHORS — JOHNSTON, W.D. JR.
PUB DESC — AM. SCI., V. 65, NO. 6, PP. 729-736
DATE — 1977
CATEGORIES — EDB-140501;140505
PRIMARY CAT — EDB-140501
ABSTRACT — A REVIEW OF PHOTOVOLTAIC CONVERSION TECHNOLOGY AND FACTORS WHICH AFFECT ITS PROSPECTIVE ECONOMIC UTILIZATION IS PRESENTED FOR AN ENGINEER/SCIENTIST READER. BASIC PRINCIPLES OF SOLAR CELL OPERATION, SOLAR CELL ARRAYS AND CONCENTRATORS ARE DISCUSSED. TECHNOLOGICAL APPROACHES TO SOLAR CELL MATERIALS AND FABRICATION THAT HAVE ESTABLISHED EFFICIENCIES ARE REVIEWED. NEW RESEARCH DIRECTIONS, INCLUDING THIN-FILM, AND LIQUID/SOLID CELLS ARE OVERVIEWED. THE PROSPECTS AND POTENTIAL OF THESE NEW

APPROACHES, AS WELL AS THE PROSPECTS FOR PHOTOVOLTAIC CONVERSION IN GENERAL ARE DISCUSSED. IT IS CONCLUDED THAT SOLAR CELLS COULD POSSIBLY PROVIDE ABOUT 30 PERCENT OF PREDICTED TOTAL ELECTRICAL POWER REQUIREMENTS. A LIST OF 20 REFERENCES IS APPENDED. (RME)

DESCRIPTORS — DESIGN;ECONOMICS;EFFICIENCY;FABRICATION;FEASIBILITY STUDIES; LIQUIDS;MATERIALS;OPERATION;PHOTOELECTROLYTIC CELLS; PHOTOGALVANIC CELLS: T;PHOTOVOLTAIC CONVERSION: T1;RESEARCH PROGRAMS;REVIEWS;SOLAR CELL ARRAYS;SOLAR CELLS: T2;SOLAR CONCENTRATORS;TECHNOLOGY ASSESSMENT: 01,02

P-71 99/5/0000001-0000095// 79

ACCESSION NO. — 78C0123642

TITLE(MONO) — ENDURANCE TESTING OF FIRST GENERATION (BLOCK I) COMMERCIAL SOLAR CELL MODULES

EDITOR OR COMP — ANAGNOSTOU, E.; FORESTIERI, A.F.

CORPORATE AUTH — NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER

SEC REPT NO — CONF-780619--13; NASA-TM--78922

PAGE NO — 9

AVAILABILITY — DEP. NTIS, PC A02/MF A01.

CONTRACT NO — CONTRACT EX-76-A-29-1022

CONF TITLE — IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE

CONF PLACE — WASHINGTON, DC, USA

CONF DATE — 5 JUN 1978

DATE — 1978

CATEGORIES — EDB-140501

PRIMARY CAT — EDB-140501

REPORT NO — DOE/NASA/1022--78/33

ABSTRACT — ONE PHASE OF THE DEPARTMENT OF ENERGY (DOE) SOLAR CELL PHOTOVOLTAIC PROGRAM IS TO DEVELOP LOW-COST SOLAR CELL ARRAYS WITH A 20-YEAR LIFETIME. IN ORDER TO HELP DETERMINE LIFETIMES OF THE FIRST GENERATION (BLOCK I) COMMERCIAL SOLAR CELL MODULES USED IN THESE ARRAYS, A PROGRAM WAS INITIATED BY DOE/NASA-LEWIS RESEARCH CENTER TO EXPOSE THESE MODULES TO A RANGE OF ENVIRONMENTS. ACCORDINGLY, BLOCK I MODULES FROM FOUR MANUFACTURERS WERE INSTALLED AT COMMERCIAL TESTING SITES IN FLORIDA, PUERTO RICO, AND ARIZONA AND AT NONCOMMERCIAL SITES IN CLEVELAND, OHIO. THE EFFECT OF OUTDOOR EXPOSURE ON THE PERFORMANCE OF THE MODULES WAS DETERMINED USING CURRENT-VOLTAGE CURVES. SHORT-CIRCUIT CURRENT (I/SUB SC/) AND MAXIMUM POWER (P/SUB MAX/) WERE THE PARAMETERS MONITORED. IN ORDER TO DETERMINE THE EFFECT OF DIRT ON PERFORMANCE, SOME MODULES WERE WASHED PERIODICALLY AND THEIR PARAMETERS WERE RECORDED BOTH BEFORE AND AFTER WASHING. IN ALL CASES, THERE WAS A LOSS OF PERFORMANCE OF THE MODULES WITH OUTDOOR EXPOSURE. THE LOSS WAS DEPENDENT NOT ONLY ON THE EXPOSURE SITE BUT ALSO ON THE MODULE CONSTRUCTION. THREE TYPES OF MODULES ARE COVERED WITH SILICONE POTTANTS AND ONE TYPE HAS, IN ADDITION, A GLASS COVER. THIS LATTER TYPE OF MODULE HAD A LOSS IN P/SUB MAX/ ONLY ONE-QUARTER TO ONE-SIXTH THAT OF THE OTHER MODULES IN A COMPARABLE PERIOD OF TIME. FOR ALL MODULES, SOME OF THE PERFORMANCE LOSS COULD BE RECOVERED BY WASHING. EXCEPT FOR GLASS-COVERED MODULES, WHERE THE LOSS IN P/SUB MAX/ COULD BE COMPLETELY RECOVERED EACH TIME, EACH SUCCEEDING WASHING RECOVERED LESS. THUS, THE SILICONE-COVERED MODULES SHOWED A PERMANENT LOSS IN PERFORMANCE. MANY MODULES SHOWED EDGE DELAMINATIONS AND/OR DELAMINATIONS UNDER CELLS AND INTERCONNECTS. THESE DID NOT SEEM TO SERIOUSLY AFFECT POWER OUTPUT. RESULTS FROM THESE EXPOSURE TESTS INDICATE THAT DELAMINATION AND DIRT RETENTION ARE LIKELY TROUBLE SPOTS IN SOLAR CELL MODULES.

DESCRIPTORS — COVERINGS;ELECTRICAL PROPERTIES;GLASS;HUMIDITY;PERFORMANCE; SERVICE LIFE: Q1;SOLAR CELL ARRAYS: T1;TEMPERATURE EFFECTS; TESTING: Q1;WASHING;WEATHERING

P-72 99/5/0000001-0000095// 80

ACCESSION NO. — 78R0107765

TITLE(MONO) — DESIGN AND FABRICATION OF A PHOTOVOLTAIC POWER SYSTEM FOR THE PAPAGO INDIAN VILLAGE OF SCHUCHULI (GUNSIGHT), ARIZONA

EDITOR OR COMP — BIFANO, W.J.; RATAJCZAK, A.F.; ICE, W.J.

CORPORATE AUTH — NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER

SEC REPT NO — CONF-780619--12; NASA-TM--78948

PAGE NO — 10

AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EY-76-A-29-1022
CONF TITLE	IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	5 JUN 1978
DATE	1978
CATEGORIES	EDB-140600;140501
PRIMARY CAT	EDB-140600
AUGMENTATION	3.5 KW
REPORT NO	DOE/NASA/1022--78/39
ABSTRACT	IN ITS ROLE OF SUPPORTING THE DOE NATIONAL PHOTOVOLTAIC PROGRAM, THE NASA-LERC IS DESIGNING AND FABRICATING A STAND-ALONE PHOTOVOLTAIC POWER SYSTEM FOR INSTALLATION IN THE PAPAGO INDIAN VILLAGE OF SCHUCHULI, LOCATED APPROXIMATELY 120 MILES WEST OF TUCSON, AZ. THIS VILLAGE PRESENTLY HAS NO ELECTRICAL POWER. THE PHOTOVOLTAIC SYSTEM IS BEING DESIGNED TO PROVIDE ELECTRICITY FOR VILLAGE WATER PUMPING AND BASIC DOMESTIC NEEDS AS PART OF A COST-SHARED EXPERIMENT INVOLVING LERC, THE U.S. PUBLIC HEALTH SERVICE AND THE PAPAGO TRIBE OF ARIZONA. THE SYSTEM WILL CONSIST OF A 3.5 KW (PEAK) PHOTOVOLTAIC ARRAY; CONTROLS, INSTRUMENTATION, AND STORAGE BATTERIES LOCATED IN AN ELECTRICAL EQUIPMENT BUILDING; AND A 120 VOLT DC VILLAGE DISTRIBUTION NETWORK. THE PHOTOVOLTAIC SYSTEM WILL POWER A 2 HP DC ELECTRIC MOTOR (REPLACING AN EXISTING DIESEL ENGINE) FOR WATER PUMPING; 15 REFRIGERATION UNITS, A WASHING MACHINE AND A SEWING MACHINE IN A DOMESTIC SERVICES BUILDING; AND FLUORESCENT LIGHTS IN THE FEAST HOUSE, CHURCH AND EACH OF THE 15 HOMES IN THE VILLAGE.
DESCRIPTORS	APPLIANCES;ARIZONA;CLOTHES WASHERS;COMMUNITIES: M1;DESIGN: Q2; DIRECT CURRENT;ELECTRIC BATTERIES;LIGHTING SYSTEMS;OVERHEAD POWER TRANSMISSION;PHOTOVOLTAIC POWER PLANTS: M2,Q1;POWER RANGE 1-10 KW;PUMPS;REFRIGERATORS;REMOTE AREAS;SIZE;SOLAR CELL ARRAYS

P-73 99/5/0000001-0000095// 81

ACCESSION NO.	78C0107726
TITLE(MONO)	DESCRIPTION AND STATUS OF NASA-LERC/DOE PHOTOVOLTAIC APPLICATIONS SYSTEMS EXPERIMENTS
EDITOR OR COMP	RATAJCZAK, A.F.
CORPORATE AUTH	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO	NASA-TM--78930; CONF-780619--17
PAGE NO	11
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1022
CONF TITLE	IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	5 JUN 1978
DATE	1978
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	DOE/NASA/1022--78/36
ABSTRACT	IN ITS ROLE OF SUPPORTING THE DOE PHOTOVOLTAIC PROGRAM, THE NASA-LEWIS RESEARCH CENTER HAS DESIGNED, FABRICATED AND INSTALLED 16 GEOGRAPHICALLY DEPERSED PHOTOVOLTAIC SYSTEMS. THESE SYSTEMS ARE POWERING A REFRIGERATOR, HIGHWAY WARNING SIGN, FOREST LOOKOUT TOWERS, REMOTE WEATHER STATIONS, A WATER CHILLER AT A VISITOR CENTER, AND INSECT SURVEY TRAPS. EACH OF THESE SYSTEMS IS DESCRIBED IN TERMS OF LOAD REQUIREMENTS, SOLAR ARRAY AND BATTERY SIZE, AND INSTRUMENTATION AND CONTROLS. OPERATIONAL EXPERIENCE IS DESCRIBED AND PRESENT STATUS IS GIVEN FOR EACH SYSTEM. THE P/V POWER SYSTEMS HAVE PROVEN TO BE HIGHLY RELIABLE WITH ALMOST NO PROBLEMS WITH MODULES AND VERY FEW PROBLEMS OVERALL.
DESCRIPTORS	DEMONSTRATION PROGRAMS: Q1;LIGHTING SYSTEMS;OPERATION; PERFORMANCE;POWER SUPPLIES;REFRIGERATORS;REMOTE AREAS;ROADS; SOLAR CELL ARRAYS: T1;USES: Q1

P-74 99/5/0000001-0000095// 82

ACCESSION NO.	78X0101020
TITLE(MONO)	ACCELERATED/ABBREVIATED TEST METHODS. STUDY 4 OF TASK 3 (ENCAPSULATION) OF THE LOW-COST SILICON SOLAR ARRAY PROJECT. EIGHTH QUARTERLY PROGRESS REPORT, JANUARY--MARCH 1978
EDITOR OR COMP	KOLYER, J.M.
CORPORATE AUTH	ROCKWELL INTERNATIONAL CORP., ANAHEIM, CALIF. (USA). AUTONETICS

	STRATEGIC SYSTEMS DIV.
PAGE NO	70
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT NAS-7-100-954458
DATE	3 APR 1978
CATEGORIES	EDB-140501;360405
PRIMARY CAT	EDB-140501
REPORT NO	DOE/JPL/954458--9
ABSTRACT	TO MEET THE GOALS OF THE LSSA PROGRAM, SOLAR CELL ENCAPSULANTS MUST PROVIDE PROTECTION FOR 20 YEARS. CONSEQUENTLY, THE OBJECTIVE OF THE PRESENT PROGRAM IS TO DEVELOP METHODOLOGY FOR MAKING CONFIDENT PREDICTIONS OF ENCAPSULANT PERFORMANCE AT ANY EXPOSURE SITE IN THE U.S.A. DURING THE FIRST YEAR OF THE PROGRAM, INHERENT WEATHERABILITY WAS STUDIED. INHERENT WEATHERABILITY IS CONTROLLED BY THE THREE WEATHER FACTORS COMMON TO ALL EXPOSURE SITES: INSOLATION, TEMPERATURE, AND HUMIDITY. EMPHASIS WAS FOCUSED ON THE TRANSPARENT ENCAPSULANT PORTION OF MINIATURE SOLAR CELL ARRAYS BY ELIMINATING WEATHERING EFFECTS ON THE SUBSTRATE AND CIRCUITRY (WHICH ARE ALSO PARTS OF THE ENCAPSULANT SYSTEM). THE MOST EXTENSIVE DATA WERE FOR YELLOWING, WHICH WAS MEASURED CONVIENTLY AND PRECISELY. CONSIDERABLE DATA ALSO WERE OBTAINED ON TENSILE STRENGTH. CHANGES IN THESE TWO PROPERTIES AFTER OUTDOOR EXPOSURE WERE PREDICTED VERY WELL FROM ACCELERATED EXPOSURE DATA. ALTHOUGH MORE OUTDOOR EXPOSURE DATA WILL BE RECEIVED, MATHEMATICAL MODELING STUDIES ARE CONTINUING. THIS FIRST PART OF THE PROGRAM CAN BE SAID TO BE SUCCESSFULLY CONCLUDED. IN CONTINUATION OF THE INHERENT WEATHERABILITY STUDY, THE POWER OUTPUT OF SOLAR CELLS WAS MONITORED UNDER ACCELERATED TEST CONDITIONS AND IS BEING FOLLOWED FOR OUTDOOR EXPOSURES. FOR THIS PURPOSE, UNIVERSAL TEST SPECIMENS (UTS'S) WITH NINE DIFFERENT SUBSTRATE/TRANSPARENT ENCAPSULANT COMBINATIONS WERE PREPARED. AGAIN, THE OBJECTIVE IS TO PREDICT OUTDOOR PERFORMANCE FROM ACCELERATED EXPOSURE DATA WITH PHOTOCHEMICAL STRESSES OF ABOUT 6 TIMES NORMAL. CONTINUOUS ACCELERATED EXPOSURE UNDER 6 KEY COMBINATIONS OF ULTRAVIOLET (UV) LIGHT INTENSITY, TEMPERATURE, AND HUMIDITY WAS CONTINUED FOR 2 MONTHS. THEN THE SAME UTS'S WERE EXPOSED TO 100% RELATIVE HUMIDITY AT 100$SUP 0$C FOR ONE MONTH. DEGRADATION EFFECTS ARE DISCUSSED AND ILLUSTRATED.
DESCRIPTORS	CONNECTORS;COPPER;COVERINGS;DATA;ELECTRICAL PROPERTIES; ELECTRONIC CIRCUITS;ENCAPSULATION: Q1,Q2;GLASS;HUMIDITY; INSULATION;MATHEMATICAL MODELS;OPTICAL PROPERTIES;PERFORMANCE TESTING: Q1,Q2;PLASTICS: T3;SERVICE LIFE;SOLAR CELL ARRAYS: T2; SOLAR CELLS: T1;TEMPERATURE EFFECTS;TENSILE PROPERTIES;THERMAL DEGRADATION;ULTRAVIOLET RADIATION;WEATHERING: Q1,Q2,Q3

P-75

ACCESSION NO.	76R0101012
TITLE(MONO)	MEASUREMENT TECHNIQUES AND INSTRUMENTS SUITABLE FOR LIFE-PREDICTION TESTING OF PHOTOVOLTAIC ARRAYS. INTERIM REPORT
EDITOR OR COMP	NOEL, G.T.; SLIEMERS, F.A.; DERINGER, G.C.; WOOD, V.E.; WILKES, K.E.; GAINES, G.B.; CARMICHALL, D.C.
CORPORATE AUTH	BATTELLE COLUMBUS LABS., OHIO (USA)
PAGE NO	195
AVAILABILITY	DEP. NTIS, PC A09/MF A01.
CONTRACT NO	CONTRACT NAS-7-100-954328
DATE	15 JAN 1976
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	DOE/JPL/954328--7
ABSTRACT	THE VALIDATION OF A SERVICE LIFE OF 20 YEARS FOR LOW-COST PHOTOVOLTAIC ARRAYS MUST BE ACCOMPLISHED THROUGH ACCELERATED LIFE-PREDICTION TESTS. A METHODOLOGY FOR SUCH TESTS HAS BEEN DEVELOPED IN A PRECEDING STUDY. THE RESULTS DISCUSSED CONSIST OF THE INITIAL IDENTIFICATION AND ASSESSMENT OF ALL KNOWN MEASUREMENT TECHNIQUES AND INSTRUMENTS THAT MIGHT BE USED IN THESE LIFE-PREDICTION TESTS. ARRAY FAILURE MODES, RELEVANT MATERIALS PROPERTY CHANGES, AND PRIMARY DEGRADATION MECHANISMS ARE DISCUSSED AS A PREREQUISITE TO IDENTIFYING SUITABLE MEASUREMENT TECHNIQUES AND INSTRUMENTS. CANDIDATE TECHNIQUES AND INSTRUMENTS ARE IDENTIFIED ON THE BASIS OF EXTENSIVE REVIEWS OF PUBLISHED AND UNPUBLISHED INFORMATION. THESE METHODS ARE ORGANIZED IN SIX MEASUREMENT CATEGORIES--CHEMICAL, ELECTRICAL, OPTICAL, THERMAL, MECHANICAL, AND ''OTHER PHYSICALS''. USING SPECIFIED EVALUATION CRITERIA, THE MOST PROMISING TECHNIQUES AND INSTRUMENTS FOR USE IN LIFE-PREDICTION TESTS OF ARRAYS ARE THEN SELECTED. THESE RECOMMENDED TECHNIQUES AND THEIR CHARACTERISTICS ARE DESCRIBED. RECOMMENDATIONS ARE MADE REGARDING ESTABLISHMENT OF THE ADEQUACY, PARTICULARLY WITH RESPECT TO PRECISION, OF THE MORE FULLY DEVELOPED TECHNIQUES FOR THIS APPLICATION, AND REGARDING THE EXPERIMENTAL EVALUATION OF PROMISING DEVELOPMENTAL TECHNIQUES. MEASUREMENT NEEDS NOT SATISFIED BY PRESENTLY AVAILABLE TECHNIQUES/INSTRUMENTS ARE ALSO IDENTIFIED.
DESCRIPTORS	CHEMICAL PROPERTIES;COMPARATIVE EVALUATIONS;CONNECTORS; COVERINGS: T2;DATA ANALYSIS;ELECTRIC CONTACTS;ELECTRICAL PROPERTIES;ENCAPSULATION;FAILURES;FORECASTING;GLASS;HUMIDITY; MEASURING INSTRUMENTS;MEASURING METHODS;MECHANICAL PROPERTIES; MOISTURE;OPTICAL PROPERTIES;PERFORMANCE TESTING: Q1,Q2;PHYSICAL PROPERTIES;POLYMERS;RECOMMENDATIONS;SEALS;SERVICE LIFE: Q1,Q2; SOLAR CELL ARRAYS: T1;SPECTRAL RESPONSE;SPECTROSCOPY;THERMAL CONDUCTIVITY;THERMAL DEGRADATION;THERMODYNAMIC PROPERTIES; ULTRAVIOLET RADIATION;WEATHERING;WIND

P-76

ACCESSION NO.	76R0056923
TITLE(MONO)	CONCEPTUAL DESIGN AND SYSTEMS ANALYSIS OF PHOTOVOLTAIC POWER SYSTEMS. VOLUME III(1). TECHNOLOGY
EDITOR OR COMP	PITTMAN, P.F.
CORPORATE AUTH	WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA. (USA). PWR SYSTEMS DIV.
PAGE NO	571
AVAILABILITY	DEP. NTIS, PC A24/MF A01.
CONTRACT NO	CONTRACT EY-76-C-04-2744
DATE	MAY 1977
CATEGORIES	EDB-140600;140501;250900
PRIMARY CAT	EDB-140600
REPORT NO	ALO--2744-13(VOL.3)(PT.1)
ABSTRACT	CONCEPTUAL DESIGNS WERE MADE AND ANALYSES WERE PERFORMED ON THREE TYPES OF SOLAR PHOTOVOLTAIC POWER SYSTEMS. INCLUDED WERE RESIDENTIAL (1 TO 10 KW), INTERMEDIATE (0.1 TO 10 MW), AND CENTRAL (50 TO 1000 MW) POWER SYSTEMS TO BE INSTALLED IN THE 1985 TO 2000 TIME PERIOD. SUBSYSTEM TECHNOLOGY PRESENTED HERE INCLUDES: INSOLATION, CONCENTRATION, SILICON SOLAR CELL MODULES, CDS SOLAR CELL MODULE, ARRAY STRUCTURE, BATTERY ENERGY STORAGE, POWER CONDITIONING, RESIDENTIAL POWER SYSTEM ARCHITECTURAL DESIGNS, INTERMEDIATE POWER SYSTEM STRUCTURAL DESIGN, AND CENTRAL POWER SYSTEM FACILITIES AND SITE SURVEY.
DESCRIPTORS	ARCHITECTURE;CADMIUM SULFIDE SOLAR CELLS: T4;DESIGN: Q1; ELECTRIC BATTERIES: T5;ENERGY STORAGE SYSTEMS;INSOLATION; INVERTERS;PHOTOVOLTAIC POWER PLANTS: T1,Q6;POWER CONDITIONING

CIRCUITS;POWER RANGE 1-10 KW;POWER RANGE 1-10 MW;POWER RANGE 10-100 MW;POWER RANGE 100-1000 MW;RESIDENTIAL BUILDINGS: T6; REVIEWS;SILICON SOLAR CELLS: T3;SITE SELECTION;SOLAR CELL ARRAYS: T2;SOLAR CONCENTRATORS;SYSTEMS ANALYSIS: Q1;TECHNOLOGY ASSESSMENT: Q1,Q2,Q3,Q4,Q5

P-77 94/5/0000001-0000095// 84

ACCESSION NO.	78R0068912
TITLE(MONO)	CONCEPTUAL DESIGN AND SYSTEMS ANALYSIS OF PHOTOVOLTAIC POWER SYSTEMS. FINAL REPORT. VOLUME V. ADDITIONAL STUDIES
EDITOR OR COMP	PITTMAN, P.F.
CORPORATE AUTH	WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA. (USA). RESEARCH AND DEVELOPMENT CENTER
PAGE NO	357
AVAILABILITY	DEP. NTIS, MF A01.
CONTRACT NO	CONTRACT EY-76-C-04-2744
DATE	MAR 1977
DROP NOTE	PORTIONS OF DOCUMENT ARE ILLEGIBLE
CATEGORIES	EDB-140600
PRIMARY CAT	EDB-140600
REPORT NO	ALO--2744-13(VOL.5)
ABSTRACT	IN THE FIRST OF FOUR TASKS, THE PERFORMANCES OF AUTONOMOUS (STAND-ALONE) RESIDENCES WERE DETERMINED IN SEVEN LOCATIONS THROUGHOUT THE COUNTRY. A NON-AUTONOMOUS RESIDENCE MUST OBTAIN ITS SUPPLEMENTAL ENERGY FROM A UTILITY. THE SECOND TASK DEALT WITH CONSIDERATIONS OF THE RATE TO BE CHARGED BY THE UTILITY FOR THIS ENERGY IN AN EFFORT TO DEFINE THE PERTINENT ISSUES OF THIS UTILITY/RESIDENCE INTERFACE. IN THE THIRD TASK, THE CONFIGURATION OF A FIXED LINEAR FRESNEL LENS PROVIDED WITH A TRACKING ABSORBER WAS ANALYZED OPTICALLY. THE FOURTH TASK EXPLORED UTILITY LOSS-OF-LOAD PROBABILITY METHODOLOGY.
DESCRIPTORS	CHARGES;ELECTRIC UTILITIES: T4;EQUIPMENT INTERFACES;FEASIBILITY STUDIES: Q2;FRESNEL LENS: T3;LOAD MANAGEMENT: Q4;OPTIMIZATION: Q3;PERFORMANCE;PHOTOVOLTAIC POWER PLANTS: T2,Q1;RELIABILITY; RESIDENTIAL BUILDINGS: T1;SIMULATION;SOLAR ABSORBERS;SOLAR CELL ARRAYS;SOLAR TRACKING;TOTAL ENERGY SYSTEMS

P-78 94/5/0000001-0000095// 85

ACCESSION NO.	78R0056802
TITLE(MONO)	MISSION ANALYSIS OF PHOTOVOLTAIC SOLAR ENERGY CONVERSION. VOLUME IV. SUPPLEMENTARY STUDIES
EDITOR OR COMP	LEONARD, S.L.; BREISACHER, P.; MUNJAL, P.K.; NEISS, J.A.
CORPORATE AUTH	AEROSPACE CORP., EL SEGUNDO, CA (USA). ENERGY AND TRANSPORTATION DIV.
PAGE NO	131
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EY-76-C-03-1101
DATE	MAR 1977
CATEGORIES	EDB-140501;200106
PRIMARY CAT	EDB-140501
REPORT NO	SAN--1101/PA6-1/4
ABSTRACT	A DISCUSSION IS PRESENTED OF THE MOST SIGNIFICANT PROBLEMS ASSOCIATED WITH THE PRODUCTION AND DEPLOYMENT OF PHOTOVOLTAIC ARRAYS. THE PRINCIPAL CHEMICAL COMPOUNDS TO BE USED IN THE MANUFACTURE OF SILICON, GALLIUM ARSENIDE, AND CADMIUM SULFIDE PHOTOVOLTAIC ARRAYS ARE DISCUSSED WITH RESPECT TO PHYSICAL AND CHEMICAL PROPERTIES, SOURCES OF THE RAW MATERIALS REQUIRED TO EXTRACT OR SYNTHESIZE THESE MATERIALS, THE METHODS OF MANUFACTURE, STORAGE AND HANDLING IN LARGE QUANTITIES, TRANSPORTATION RESTRICTIONS, SPILLS, LEAKS, IGNITION AND EXPLOSION. A DISCUSSION OF SAFETY HAZARDS ASSOCIATED WITH THE FINISHED PRODUCTS IS FOLLOWED BY AN ANALYSIS OF THE TOXICOLOGICAL PROPERTIES OF ALL RAW, REFINED, AND FINISHED CHEMICAL SPECIES INVOLVED. THE PRINCIPAL TOOL USED IN THE EVALUATION OF INCENTIVE STRATEGIES WAS A NEW PUBLIC UTILITY FINANCIAL ANALYSIS AND PLANNING MODEL WHICH IS DESCRIBED IN SOME DETAIL. AFTER ADAPTATION TO MATCH THE CHARACTERISTICS OF PHOTOVOLTAIC PLANTS, IT WAS USED IN THE COMPARATIVE EVALUATION OF SIX DIFFERENT INCENTIVE STRATEGIES. THE CANDIDATE STRATEGIES, THE RATIONALE FOR THEIR SELECTION, AND THE RESULTS OF THE COMPARATIVE EVALUATION ARE PRESENTED. AN ACCOUNT IS GIVEN OF AN ATTEMPT TO ASSESS THE FULL NON-INTERNALIZED COSTS OF COAL-FIRED POWER GENERATION. A DETAILED DESCRIPTION IS GIVEN OF THE VARIOUS DAMAGE ELEMENTS AND THEIR ASSOCIATED SOCIETAL

COSTS FOR COAL PRODUCTION, COAL TRANSPORTATION, AND COAL-FIRED POWER GENERATION. (MHR)

SPLITS

CADMIUM SULFIDE SOLAR CELLS;GALLIUM ARSENIDE SOLAR CELLS;HEALTH HAZARDS: 01;MANUFACTURING;MATERIALS;PRODUCTION: 01;SAFETY: 01; SILICON SOLAR CELLS;SOLAR CELL ARRAYS: T1;TOXIC MATERIALS; TRANSPORT

COST;ECONOMIC ANALYSIS: 02;FINANCIAL INCENTIVES: 02; PHOTOVOLTAIC POWER PLANTS: T2;TAXES

COAL;COAL MINING;COAL PREPARATION;ECONOMICS: 03;FOSSIL-FUEL POWER PLANTS: T3;TRANSPORT

P-79 99/5/0000001-0000095// 86

ACCESSION NO. 78R0023656

TITLE(MONO) MISSION ANALYSIS OF PHOTOVOLTAIC SOLAR ENERGY CONVERSION. VOLUME III. MAJOR MISSIONS FOR THE MID-TERM (1986--2000)

EDITOR OR COMP LEONARD, S.L.; RATTIN, E.J.; SIEGEL, B.

CORPORATE AUTH AEROSPACE CORP., EL SEGUNDO, CALIF. (USA). ENERGY AND TRANSPORTATION DIV.

PAGE NO 216

AVAILABILITY DEP. NTIS, PC A10/MF A01.

CONTRACT NO CONTRACT EY-76-C-03-1101-006

DATE MAR 1977

CATEGORIES EDB-140600;140501

PRIMARY CAT EDB-140600

REPORT NO SAN--1101/PA6-1/3

ABSTRACT THE RESULTS OF ANALYSES OF POTENTIALLY ATTRACTIVE APPLICATIONS FOR PHOTOVOLTAIC SOLAR ENERGY SYSTEMS IN THE 1985--2000 TIME PERIOD ARE PRESENTED. PRIMARY EMPHASIS HAS BEEN GIVEN TO STUDIES OF CENTRAL STATION POWER PLANT APPLICATIONS, LARGELY BECAUSE IT IS BELIEVED THAT PHOTOVOLTAIC SYSTEMS WILL HAVE TO ACHIEVE AN APPRECIABLE PENETRATION OF THAT MARKET IF THEY ARE TO MAKE A SIGNIFICANT (1--2%) CONTRIBUTION TO THE NATION'S ENERGY SUPPLY BY THE YEAR 2000. EARLIER ANALYSES OF SUCH APPLICATIONS HAVE BEEN EXTENDED IN THE CURRENT STUDY IN ORDER TO DEVELOP INFORMATION ON SUCH ISSUES AS: THE DESIRABILITY OF CONCENTRATING SYSTEMS; THE FEASIBILITY AND ECONOMICS OF USING THE WASTE HEAT AVAILABLE FROM HIGH CONCENTRATION WATER-COOLED SYSTEMS; THE EFFECT OF GEOGRAPHIC LOCATION AND FOSSIL FUEL PRICES AND PRICE ESCALATION RATES ON ALLOWABLE ARRAY PRICES; THE ATTRACTIVENESS OF ELECTRICAL STORAGE; AND THE EFFECT OF RELAXING UTILITY RELIABILITY REQUIREMENTS. IN ORDER TO CONDUCT THESE ANALYSES, A NUMBER OF SUPPORTING ACTIVITIES WERE COMPLETED.

DESCRIPTORS ECONOMIC ANALYSIS: 01,02;ELECTRIC UTILITIES;ENERGY STORAGE SYSTEMS;FEASIBILITY STUDIES: 01,02;MARKET;PHOTOVOLTAIC POWER PLANTS: T2;RELIABILITY;RESIDENTIAL BUILDINGS;SOLAR CELL ARRAYS: T1;SOLAR CONCENTRATORS;TOTAL ENERGY SYSTEMS;USES

P-80 99/5/0000001-0000095// 87

ACCESSION NO. 78R0083662

TITLE(MONO) DESIGN DATA HANDBOOK FOR FLEXIBLE SOLAR ARRAY SYSTEMS

EDITOR OR COMP PARQUET, D.J.

CORPORATE AUTH LOCKHEED MISSILES AND SPACE CO., SUNNYVALE, CALIF. (USA)

SEC REPT NO LMSC-D--159618

PAGE NO 260

AVAILABILITY NTIS PC A11/MF A01.

CONTRACT NO CONTRACT NAS9-11039

DATE MAR 1973

CATEGORIES EDB-140501

PRIMARY CAT EDB-140501

REPORT NO N--74-75793

ABSTRACT CONTENTS INCLUDE: SOLAR ARRAY COMPONENT DESIGN DATA(SOLAR ARRAY STRUCTURE; SOLAR ARRAY SUBSTRATE ASSEMBLY; SOLAR ARRAY DRIVE SYSTEMS; POWER AND SIGNAL TRANSFER DEVICES; LUBRICATION); SOLAR ARRAY SYSTEM DESIGN AND SIZING CRITERIA; AND PHYSICAL CONSTANTS AND CONVERSION FACTORS.

DESCRIPTORS DESIGN: 01;MANUALS: 01;POWER TRANSMISSION;SIZE;SOLAR CELL ARRAYS: T1;SPACECRAFT POWER SUPPLIES;SUBSTRATES

P-81 ACCESSION NO. 78C0076256
TITLE DOD/ERDA TERRESTRIAL PHOTOVOLTAIC SYSTEMS DEMONSTRATION PROGRAM
AUTHORS FAEHN, D.D.
TITLE(MONO) TWELFTH IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
PAGE NO 715-720
CONF TITLE 12. IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
CONF PLACE BATON ROUGE, LA, USA
CONF DATE 15 NOV 1976
PUBL LOC INST. OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC., NEW YORK
DATE 1976
DROP NOTE SEE CONF-761130--
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501
ABSTRACT AS THE DESIGNATED LEAD CENTER WITHIN THE DEPARTMENT OF DEFENSE FOR TERRESTRIAL APPLICATIONS OF SOLAR PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS, THE US ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMMAND (MERADCOM) HAS UNDERTAKEN A PROGRAM WITH THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION TO DEMONSTRATE THIS TECHNOLOGY IN A VARIETY OF MILITARY USES. THE PROGRAM IS DIRECTED TOWARD ESTABLISHING FEASIBILITY OF PHOTOVOLTAIC ENERGY SOURCES FOR MILITARY SYSTEMS. THREE OF THE SIX PLANNED DEMONSTRATION PROJECTS WERE INITIATED IN SEPTEMBER 1976 AND HAVE BEEN OPERATED SUCCESSFULLY AT THE MERADCOM FACILITY, CONSTITUTING THE FIRST (CENTRALIZED) DEMONSTRATION PHASE OF THE PROGRAM. THESE PROJECTS ARE TO BE TRANSPORTED TO OTHER MILITARY FACILITIES DURING FISCAL YEAR 1977, TO BE OPERATED UNDER MORE REPRESENTATIVE MILITARY ENVIRONMENTS AND TO PROMOTE MILITARY AWARENESS OF TERRESTRIAL PHOTOVOLTAIC TECHNOLOGY.
DESCRIPTORS DEMONSTRATION PROGRAMS: Q1;FEASIBILITY STUDIES;MILITARY EQUIPMENT: T2;OSMOSIS;PURIFICATION;RADAR;RADIO EQUIPMENT POWER SUPPLIES: T4;REMOTE AREAS;SOLAR BATTERY CHARGERS: T3;SOLAR CELL ARRAYS: T1,Q2,Q3,Q4;US DOD;US ERDA;WATER

99/5/COCO001-COUOO95// 89

P-82 ACCESSION NO. 78C0076248
TITLE MAJOR TERRESTRIAL APPLICATIONS FOR PHOTOVOLTAIC SOLAR ENERGY CONVERSION IN THE 1985--2000 PERIOD
AUTHORS LEONARD, S.L.
AUTHOR AFF AEROSPACE CORP., EL SEGUNDO, CA
TITLE(MONO) TWELFTH IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
PAGE NO 641-652
CONF TITLE 12. IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
CONF PLACE BATON ROUGE, LA, USA
CONF DATE 15 NOV 1976
PUBL LOC INST. OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC., NEW YORK
DATE 1976
DROP NOTE SEE CONF-761130--
CATEGORIES EDB-140501;140600;140200
PRIMARY CAT EDB-140501
ABSTRACT TECHNICAL AND ECONOMIC ANALYSES HAVE BEEN MADE OF A NUMBER OF ON-SITE RESIDENTIAL APPLICATIONS AND CENTRAL STATION APPLICATIONS FOR PHOTOVOLTAIC SOLAR ENERGY CONVERSION IN THE SOUTHWESTERN UNITED STATES IN THE 1985-2000 PERIOD. THE METHODOLOGY EMPLOYED COMPUTER SIMULATION OF THE PERFORMANCE OF THE PHOTOVOLTAIC SYSTEMS, BOTH WITH AND WITHOUT ELECTRIC STORAGE, AND INCLUDED A RELIABILITY ANALYSIS PROCEDURE FOR DETERMINING THE AMOUNT OF BACKUP CONVENTIONAL GENERATION CAPACITY WHICH WOULD BE SUFFICIENT TO MAINTAIN RELIABILITY OF SERVICE DURING NON-INSOLATION PERIODS. IT WAS DETERMINED THAT, FOR REASONABLE FUEL-PRICE PROJECTIONS, PHOTOVOLTAIC SYSTEMS WOULD BE COST EFFECTIVE IN EITHER TYPE OF APPLICATION WHEN ARRAY PRICES ARE IN THE $100 TO $300/KW/SUB PK/ RANGE (1976 DOLLARS).
DESCRIPTORS ECONOMIC ANALYSIS: Q1,Q2;ENERGY STORAGE;FEASIBILITY STUDIES: Q1,Q2;PERFORMANCE;PHOTOVOLTAIC CONVERSION: T1;PHOTOVOLTAIC POWER PLANTS: T2;RELIABILITY;RESIDENTIAL BUILDINGS: T3; SIMULATION;SOLAR CELL ARRAYS: Q3;SOLAR CONCENTRATORS;SYSTEMS ANALYSIS;USA

99/5/COCO001-COUOO95// 90

P-83 ACCESSION NO. 78U0073550
REPORT NO.PAGE ALO--274-1,(VOL.4 PP. 6.1-5.33
TITLE CENTRAL POWER STATION OPERATIONAL AND ECONOMIC ANALYSIS

TITLE(MONO) PHOTOVOLTAIC SYSTEMS CONCEPT STUDY
PAGE NO 8.1-8.35
DATE APR 1977
CATEGORIES EDB-140600;140300
PRIMARY CAT EDB-140600
REPORT NO ALO--2748-12(VOL.4)
ABSTRACT THE FOLLOWING TOPICS ARE COVERED: OPERATIONAL ANALYSIS AND PLANT RATING, COMPUTER SIMULATION RESULTS, AND ECONOMIC ANALYSIS. (MHR)
DESCRIPTORS ECONOMIC ANALYSIS: Q1;OPERATION: Q1;PHOTOVOLTAIC POWER PLANTS: T1;SIMULATION

P-84 99/5/0000001-0000095// 91
ACCESSION NO. 78C0073349
REPORT NO.PAGE ALO--2748-12(VOL.4 PP. 7.1-7.79
TITLE CENTRAL POWER STATION DESIGN
TITLE(MONO) PHOTOVOLTAIC SYSTEMS CONCEPT STUDY
PAGE NO 7.1-7.79
DATE APR 1977
CATEGORIES EDB-140600
PRIMARY CAT EDB-140600
REPORT NO ALO--2748-12(VOL.4)
ABSTRACT THE CONCEPTUAL DESIGN FOR THE PHOTOVOLTAIC CENTRAL STATION POWER PLANT IS DESCRIBED. TWO DESIGN OPTIONS, ONSITE STORAGE AND NO STORAGE, ARE CONSIDERED. THE CRITERIA USED AS A BASIS FOR THE DESIGNS ARE CONSIDERED. A BRIEF DESCRIPTION OF THE PLANT IS GIVEN IN ORDER TO PUT ENSUING DETAILED DISCUSSIONS INTO PERSPECTIVE. THE SIZING OF THE PLANT AND ITS SYSTEMS IS DISCUSSED. THE PLANT COMPONENTS ARE DISCUSSED IN DETAIL. PLANT OPERATION AND ECONOMICS ARE DESCRIBED.
DESCRIPTORS DESIGN: Q1;ECONOMICS;OPERATION;PHOTOVOLTAIC POWER PLANTS: T1;SIZE

P-85 99/5/0000001-0000095// 92
ACCESSION NO. 78C0073347
REPORT NO.PAGE ALO--2748-12(VOL.3 PP. 6.1-6.78
TITLE SIMPLIFIED DESIGN METHOD FOR ON-SITE APPLICATIONS
TITLE(MONO) PHOTOVOLTAIC SYSTEMS CONCEPT STUDY
PAGE NO 6.1-6.78
DATE APR 1977
CATEGORIES EDB-140600;140100
PRIMARY CAT EDB-140600
REPORT NO ALO--2748-12(VOL.3)
ABSTRACT USING COMPUTER SIMULATIONS TO CHECK THE FORMULAS, METHODS WERE DEVELOPED OF ESTIMATING SOLAR FRACTIONS OF AN ON-SITE LOAD FROM MONTHLY AVERAGE INSOLATION DATA. METHODS OF ESTIMATING INSOLATION ARE PRESENTED FOR VARIOUS ARRAY TYPES FOR ALL PARTS OF THE CONTINENTAL UNITED STATES. LOADS ARE BRIEFLY DISCUSSED. SOLAR FRACTION FORMULAS SUITABLE FOR HAND CALCULATION FROM AVAILABLE MONTHLY INSOLATION DATA ARE GIVEN. THESE FORMULAS LEAD TO DESIGN METHODS FOR SIZING ON-SITE SOLAR POWER SYSTEMS WITH UTILITY BACKUP. COMPARISONS ARE PRESENTED OF SOLAR FRACTIONS FROM COMPUTER SIMULATIONS TO THOSE PREDICTED WITH THE FORMULAS. THE MAGNITUDE OF THE ERRORS IN PREDICTION (AVERAGE 6 PERCENT, MAXIMUM 15 PERCENT) DUE TO THE FORMULAS COMPARES QUITE WELL TO THE YEAR-TO-YEAR VARIABILITY IN MONTHLY INSOLATION. A SUMMARY OF THE DESIGN METHOD AND RECOMMENDATIONS FOR SIZING ON-SITE SYSTEMS ARE GIVEN.
DESCRIPTORS AVAILABILITY;CLOUD COVER;COMPUTER CALCULATIONS;DAILY VARIATIONS;DATA: Q1,DESIGN;ELECTRIC POWER;ENERGY STORAGE;INSOLATION: T1,Q3;LATITUDE EFFECT;POWER GENERATION: Q3;SEASONAL VARIATIONS;SIMULATION: Q2;SIZE;SOLAR CELL ARRAYS: T3;SOLAR FLUX: T2;SOLAR TRACKING

P-86 99/5/0000001-0000095// 93
ACCESSION NO. 78C0073344
REPORT NO.PAGE ALO--2748-12(VOL.2 PP. 4.1-4.126
TITLE RESIDENTIAL ON-SITE APPLICATION
TITLE(MONO) PHOTOVOLTAIC SYSTEMS CONCEPT STUDY
PAGE NO 4.1-4.126
DATE APR 1977
CATEGORIES EDB-140600;140901
PRIMARY CAT EDB-140600
REPORT NO ALO--2748-12(VOL.2)

ABSTRACT	RESIDENTIAL ON-SITE APPLICATIONS ARE ADDRESSED IN THIS SECTION. TWO HOUSES WERE DEFINED, ONE FOR EASTERN LOCATIONS AND ONE FOR WESTERN LOCATIONS. SITE LOCATIONS OF PHOENIX AND RIVERSIDE WERE CHOSEN FOR THE WESTERN STYLE HOUSE. CLEVELAND AND WASHINGTON, D.C. WERE CHOSEN FOR THE EASTERN STYLE HOUSE. THESE HOUSES ARE DESCRIBED AND THE SPACE-CONDITIONING METHOD DEFINED. VARIOUS METHODS OF ESTABLISHING SPACE CONDITIONING LOAD REQUIREMENTS WERE DEVISED AND EVALUATED IN THE EFFORT TO DETERMINE THERMAL LOADS ACCURATELY AND EFFICIENTLY. THESE METHODS AND THEIR RESULTS ARE REVIEWED. TO EQUATE SPACE CONDITIONING LOADS TO ELECTRICAL POWER REQUIREMENTS REQUIRED DEVELOPMENT OF ANALYTICAL MODELS FOR THE VARIOUS SPACE CONDITIONING EQUIPMENT. ALSO, CONTROL SEQUENCE AND CONTROL PHILOSOPHY AND/OR CRITERIA HAD TO BE ESTABLISHED. THESE MODELS AND CONTROL CRITERIA ARE REVIEWED. THE ELECTRICAL LOADS COMPUTED FOR THE SELECTED SYSTEMS AND LOCATIONS ARE PRESENTED. THE PHOTOVOLTAIC POWER SYSTEM IS DEFINED INCLUDING THE UTILITY GRID INTERFACE AND POWER CONDITIONING EQUIPMENT. ARRAY-STORAGE TRADE-OFF STUDIES WERE CONDUCTED TO DETERMINE THE OPTIMUM RATIO OF ARRAY TO STORAGE AS A FUNCTION OF THE FRACTION OF ELECTRICAL ENERGY SUPPLIED BY THE PHOTOVOLTAIC SYSTEM. THE TECHNIQUES DEVELOPED FOR THIS OPTIMIZATION STUDY ALONG WITH THE RESULTS AND CONCLUSIONS ARE GIVEN. A COST-PERFORMANCE TRADE-OFF STUDY WAS PERFORMED TO OPTIMIZE THE SIZE OF INVERTER TO BE USED FOR THE VARIOUS APPLICATIONS. THIS WORK IS DOCUMENTED. THE ECONOMIC PERFORMANCE EVALUATION OF THESE RESIDENTIAL ON-SITE SYSTEMS IS REVIEWED. GENERAL OBSERVATIONS ALONG WITH SPECIFIC CONCLUSIONS ARE SUMMARIZED.
DESCRIPTORS	ARIZONA;CALIFORNIA;COOLING LOAD;EQUIPMENT INTERFACES;EVALUATION;FEASIBILITY STUDIES: Q2,Q3;HEATING LOAD;OHIO;PHOTOVOLTAIC POWER PLANTS: T2,Q1;RESIDENTIAL BUILDINGS: T1;ROCK BEDS;SITE SELECTION;SOLAR AIR HEATERS;SOLAR CELL ARRAYS: T3,Q1;SOLAR HEATING SYSTEMS: Q1;WASHINGTON DC

P-87

ACCESSION NO.	76C0013455
REPORT NO.,PAGE	JPL--5040-13 PP. 56-61
TITLE	LOW-COST SILICON SOLAR ARRAY PROJECT
AUTHORS	GOLDSMITH, J.V.
AUTHOR AFF	CALIFORNIA INST. OF TECH., PASADENA
TITLE(MONO)	PROCEEDINGS OF THE FIRST ERDA SEMIANNUAL SOLAR PHOTOVOLTAIC CONVERSION PROGRAM CONFERENCE
SEC REPT NO	CONF-750725--
PAGE NO	56-61
CONF TITLE	NATIONAL SOLAR PHOTOVOLTAIC PROGRAM REVIEW MEETING
CONF PLACE	LOS ANGELES, CALIFORNIA, USA
CONF DATE	22 JUL 1975
DATE	1975
CATEGORIES	EDB-140501
PRIMARY CAT	EDB-140501
REPORT NO	JPL--5040-13
ABSTRACT	THE ORGANIZATION, RELATIVE ROLES OF GOVERNMENT AND INDUSTRY, 1986 PROJECT TECHNICAL REQUIREMENTS, SUMMARY IMPROVEMENT REQUIRED, AND TASK INTERACTIONS FOR THE LOW-COST SILICON SOLAR ARRAY PROJECT ARE OUTLINED. (MHR)
DESCRIPTORS	EXPERIMENT PLANNING: Q1;ORGANIZATIONAL MODELS;RESEARCH PROGRAMS;SILICON SOLAR CELLS: T1;SOLAR CELL ARRAYS;TECHNOLOGY ASSESSMENT

P-88

ACCESSION NO.	78A0020500
TITLE(MONO)	ENGINEERING STUDY OF THE MODULE/ARRAY INTERFACE FOR LARGE TERRESTRIAL PHOTOVOLTAIC ARRAYS. FINAL REPORT
CORPORATE AUTH	BECHTEL CORP., SAN FRANCISCO, CALIF. (USA)
PAGE NO	164
AVAILABILITY	DEP. NTIS, PC A08/MF A01.
CONTRACT NO	CONTRACT NAS-7-100-954698
DATE	JUN 1977
CATEGORIES	EDB-140600;140501
PRIMARY CAT	EDB-140600
REPORT N.	ERDA/JPL/954698--77/1
ABSTRACT	SEVERAL FACTORS CONTRIBUTING TO THE DESIGN OF PHOTOVOLTAIC PANELS AND THEIR INTERFACE WITH THE ARRAY WERE STUDIED. THE STUDY'S EMPHASIS WAS ON LARGE ARRAYS, WITH A 200 MW CENTRAL STATION POWER PLANT USED FOR THE BASELINE. THREE MAJOR AREAS--STRUCTURAL, ELECTRICAL, AND MAINTENANCE--WERE EVALUATED. EFFORTS IN THE STRUCTURAL AREA INCLUDED ESTABLISHING ACCEPTANCE CRITERIA FOR MATERIALS AND MEMBERS, DETERMINING LOADING CRITERIA, AND ANALYZING GLASS MODULES IN VARIOUS FRAMING SYSTEM CONFIGURATIONS. ARRAY SUPPORT STRUCTURE DESIGN WAS ADDRESSED BRIEFLY. ELECTRICAL CONSIDERATIONS INCLUDED EVALUATION OF MODULE CHARACTERISTICS, INTERMODULE CONNECTORS, ARRAY WIRING, CONVERTERS AND LIGHTNING PROTECTION. PLANT MAINTENANCE FEATURES SUCH AS ARRAY CLEANING, FAILURE DETECTION, AND MODULE INSTALLATION AND REPLACEMENT WERE ADDRESSED.
DESCRIPTORS	CONNECTORS: Q1;COVERINGS;DESIGN: Q1,Q2;ELECTRICAL EQUIPMENT; ELECTRICAL PROPERTIES;EQUIPMENT INTERFACES;INSTALLATION; MAINTENANCE;MECHANICAL PROPERTIES;MECHANICAL STRUCTURES; PHOTOVOLTAIC POWER PLANTS: T2;POWER RANGE 100-1000 MW;SOLAR CELL ARRAYS: T1;SUPPORTS: Q1

P-89

ACCESSION NO.	80C0027401
TITLE(MONO)	LOW COST STRUCTURES FOR PHOTOVOLTAIC ARRAYS
EDITOR OR COMP	POST, H.N.
CORPORATE AUTH	SANDIA LABS., ALBUQUERQUE, NM (USA)
SEC REPT NO	CONF-800106--9
PAGE NO	6
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EY-76-C-04-0789
CONF TITLE	14. PHOTOVOLTAICS SPECIALISTS CONFERENCE
CONF PLACE	SAN DIEGO, CA, USA
CONF DATE	7 JAN 1980
DATE	1980
CATEGORIES	EDB-140600
PRIMARY CAT	EDB-140600
REPORT NO	SAND--80-0142C
ABSTRACT	THE DESIGN AND ANALYSIS OF LOW COST, GROUND-MOUNTED FLAT PLATE NON-TRACKING ARRAY STRUCTURES FOR USE IN LARGE INTERMEDIATE AND CENTRAL POWER STATION APPLICATIONS ARE DESCRIBED. DESIGN REQUIREMENTS FOR THE ARRAY STRUCTURE, ESPECIALLY WIND LOADING CRITERIA, ARE DISCUSSED AND PROBLEM AREAS ASSOCIATED WITH THE INTEGRATION OF THE MODULE PANEL AND SUPPORT STRUCTURE ARE IDENTIFIED. SUPPORT SYSTEM COSTS WHICH INCLUDE SITE PREPARATION, FOUNDATION AND SUPPORT STRUCTURE, AND INSTALLATION COSTS ARE SUMMARIZED. WIND EFFECTS DATA DERIVED FROM COMPREHENSIVE WIND TUNNEL TESTS OF FLAT PLATE ARRAY FIELD MODELS ARE PRESENTED AND COMPARED WITH WIND LOADING ESTIMATES BASED ON EXISTING DESIGN STANDARDS.
DESCRIPTORS	COMPARATIVE EVALUATIONS;COST: Q2;DYNAMIC LOADS;FOUNDATIONS; INSTALLATION;MECHANICAL STRUCTURES;PHOTOVOLTAIC POWER PLANTS; PHOTOVOLTAIC POWER SUPPLIES;SOLAR CELL ARRAYS: T1;SUPPORTS: T2,Q1;WIND

P-90

ACCESSION NO.	80R0020146
TITLE(MONO)	DESIGN OF LOW-COST STRUCTURES FOR PHOTOVOLTAIC ARRAYS. VOLUME 1 OF 2: EXECUTIVE SUMMARY. FINAL REPORT
CORPORATE AUTH	BECHTEL NATIONAL, INC., SAN FRANCISCO, CA (USA)
PAGE NO	42
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EY-76-C-04-0789
DATE	NOV 1979
CATEGORIES	EDB-140600
PRIMARY CAT	EDB-140600
REPORT NO	SAND--79-7002(VOL.1)
ABSTRACT	THIS REPORT PRESENTS THE RESULTS OF AN EXTENSIVE STUDY OF SUPPORT STRUCTURES AND FOUNDATIONS FOR PHOTOVOLTAIC SOLAR ARRAYS ARRANGED IN A CENTRAL POWER PLANT CONFIGURATION. THE OBJECTIVES OF THIS WORK WERE TO DEVELOP FEASIBLE LOW-COST STRUCTURAL DESIGNS TO SUPPORT PHOTOVOLTAIC SOLAR ARRAYS, INCLUDING THE PROVISION OF FOUNDATION DETAILS AND COST ESTIMATES OF SEVERAL FEASIBLE DESIGNS. THE RESULTING COST COMPARISONS WERE USED TO ESTABLISH THE CHARACTERISTICS OF LOW-COST SUPPORT DESIGNS. A SUMMARY OF THE STUDY APPROACH, FINDINGS, AND RECOMMENDATIONS IS PRESENTED IN THIS VOLUME.
DESCRIPTORS	BUILDING MATERIALS;COMPARATIVE EVALUATIONS;COST;DESIGN: Q3,Q4; DYNAMIC LOADS;EARTHQUAKES;FOUNDATIONS: T3,Q1,Q2;MANUFACTURERS; MECHANICAL STRUCTURES;PHOTOVOLTAIC POWER PLANTS: T1; RECOMMENDATIONS;SNOW;SOLAR CELL ARRAYS: T2;SUPPORTS: T4,Q1,Q2; TEMPERATURE EFFECTS;WIND

P-91

ACCESSION NO. 80R0026027
TITLE(MONO) REGIONAL DIFFERENCES IN ENERGY COSTS: THEIR PERSISTENCE AND IMPLICATIONS FOR SOLAR PHOTOVOLTAICS
EDITOR OR COMP KATZMAN, M.T.
CORPORATE AUTH MASSACHUSETTS INST. OF TECH., LEXINGTON (USA). LINCOLN LAB.
PAGE NO 21
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT EY-76-C-02-4094
DATE 26 SEP 1979
CATEGORIES EDB-140501;299001
PRIMARY CAT EDB-140501
REPORT NO COO--4094-56
ABSTRACT THE ECONOMIC BENEFITS OF SOLAR PHOTOVOLTAICS ARE MEASURED BY THE SAVINGS IN CONVENTIONAL ENERGY COSTS. WHERE THE CONVENTIONAL ENERGY SOURCE IS THE CENTRAL ELECTRIC GRID, INTERREGIONAL DIFFERENCES IN ELECTRIC RATES MUST BE TAKEN INTO ACCOUNT. THIS STUDY CONSIDERS THE PERSISTENCE, FUTURE COURSE, AND MAGNITUDE OF THESE INTERREGIONAL DIFFERENCES. THE MAIN CONCLUSION IS THAT DIFFERENCES OF 20% AROUND THE MEAN WILL PERSIST; THE NORTHEAST WILL REMAIN ON THE HIGH END, THE TENNESSEE VALLEY AND THE PACIFIC NORTHWEST ON THE LOW END. EVEN THOUGH THE MAGNITUDE OF INSOLATION IN THE NORTHEAST IS RELATIVELY LOW, THE HIGH COST OF ELECTRICITY BRINGS THE BENEFITS OF SOLAR PHOTOVOLTAICS IN THIS REGION UP TO THE NATIONAL AVERAGE.
DESCRIPTORS COMPARATIVE EVALUATIONS;COST: Q2,D;ECONOMICS: Q1,D;ELECTRIC POWER: T2,D; INSOLATION;MAPS;NUMERICAL DATA: D;PHOTOVOLTAIC CONVERSION;PHOTOVOLTAIC POWER PLANTS: T1,D;REGIONAL ANALYSIS: Q1;SOLAR ENERGY;TABLES: D

P-92

ACCESSION NO. 79R0129440
TITLE(MONO) PHOTOVOLTAIC CENTRAL POWER PLANTS. SOME NEW EVALUATIONS ON THE BASIS OF REVISED INSOLATION DATA
EDITOR OR COMP LEONARD, S.L.
CORPORATE AUTH AEROSPACE CORP., EL SEGUNDO, CA (USA). ENERGY AND RESOURCES DIV.
SEC REPT NO ATR--78(7694-04)-3
PAGE NO 57
AVAILABILITY DEP. NTIS, PC A04/MF A01.
CONTRACT NO CONTRACT EY-76-C-03-1101-008
DATE JUL 1978
CATEGORIES EDB-140000;299001
PRIMARY CAT EDB-140000
REPORT NO SAN--1101/PAR-11
ABSTRACT A COMPARISON OF PLANT PERFORMANCE AND COST-EFFECTIVENESS AS COMPUTED WITH TWO INSOLATION DATA BASES IS PRESENTED. THREE DIFFERENT COLLECTOR/CONCENTRATOR CONCEPTS (FLAT PEAK, NORTH-SOUTH PARABOLIC TROUGH, AND CENTRAL RECEIVER) AND OPERATION AT FOUR LOCATIONS WERE EVALUATED. IT IS CONCLUDED THAT RECENT REVISIONS IN THE INSOLATION DATA BASE DO NOT SIGNIFICANTLY CHANGE EARLIER EVALUATIONS OF FLAT-PLATE PHOTOVOLTAIC PLANTS BUT RESULT IN SIGNIFICANTLY LESS OPTIMISTIC PROJECTIONS OF COST-EFFECTIVENESS OF CONCENTRATOR PHOTOVOLTAIC SYSTEMS.
DESCRIPTORS CENTRAL RECEIVERS;COMPARATIVE EVALUATIONS;CONCENTRATION RATIO; COST;DATA: Q1;ECONOMICS: Q2;ENERGY ACCOUNTING;FORECASTING; HELIOSTATS;INSOLATION: T1;PARABOLIC REFLECTORS;PERFORMANCE: Q2; PHOTOVOLTAIC POWER PLANTS: T2;SOLAR CELL ARRAYS

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ACCESSION NO. 79U0129427
REPORT NO.PAGE ANL/OEPM--78-3 PP. 143-170
TITLE ESTIMATING THE PRESENT WORTH OF PHOTOVOLTAIC SYSTEMS TO A UTILITY
AUTHORS GOODMAN, F.R. JR.
AUTHOR AFF LOS ANGELES DEPT. OF WATER AND POWER, CA
TITLE(MONO) PROCEEDINGS OF THE WORKSHOP ON BATTERY STORAGE FOR SOLAR-PHOTOVOLTAIC ENERGY SYSTEMS
EDITOR OR COMP YAO, N.P.; BARGHUSEN, J.J. (EDS.)
PAGE NO 143-170
AVAILABILITY DEP. NTIS, PC A11/MF A01.
DATE 1978
CATEGORIES EDB-140000
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REPORT NO ANL/OEPM--78-3
ABSTRACT AN ATTEMPT IS MADE TO SHOW HOW CONVENTIONAL UTILITY TOOLS FOR POWER GENERATION PLANNING CAN BE ADAPTED TO ASSESS THE VALUE OF PHOTOVOLTAIC POWER PLANTS TO AN ELECTRIC UTILITY. A MODIFIED LOSS OF LOAD PROBABILITY (LOLP) METHODOLOGY AND REQUISITE ASSUMPTIONS FOR DETERMINING SYSTEM RELIABILITY, ALLOWABLE EFFECTIVE CAPACITY, AND PRODUCTION COSTS ARE DISCUSSED. SOME FACTORS THAT INFLUENCE EFFECTIVE CAPACITY ARE DISCUSSED: PLANT DESIGN, SITE LOCATION, COMPONENT RELIABILITY, THE PERCENTAGE OF THE TOTAL GENERATION CAPACITY ATTRIBUTABLE TO PHOTOVOLTAIC POWER PLANTS, AND AVAILABILITY OF ENERGY STORAGE. (LS)
DESCRIPTORS CAPACITY: Q1;COST: Q1;ELECTRIC POWER INDUSTRY;ELECTRIC UTILITIES;ENERGY STORAGE SYSTEMS;PEAK-LOAD PRICING;PHOTOVOLTAIC POWER PLANTS: T1;RELIABILITY: Q1

P-94

ACCESSION NO. 79R0129350
TITLE(MONO) FEDERAL PHOTOVOLTAICS UTILIZATION PROGRAM
CORPORATE AUTH DEPARTMENT OF ENERGY, WASHINGTON, DC (USA)
PAGE NO 40
AVAILABILITY DEP. NTIS, PC A03/MF A01.
DATE JUN 1979
CATEGORIES EDB-140400;140501;140600;530200
PRIMARY CAT EDB-140400
REPORT NO DOE/EA--0067
ABSTRACT THE POTENTIAL ENVIRONMENTAL EFFECTS OF SILICON CELL TECHNOLOGY ARE ANALYZED. IT IS NOTED THAT ANY POTENTIAL ENVIRONMENTAL IMPACTS OF THIS TECHNOLOGY OCCUR IN CONNECTION WITH MANUFACTURING OF SILICON CELLS AND PROPOSED APPLICATIONS OF PHOTOVOLTAIC SYSTEMS. HOWEVER, IT IS FOUND THAT THERE ARE NO KNOWN ADVERSE ENVIRONMENTAL EFFECTS ASSOCIATED WITH THE FEDERAL PHOTOVOLTAICS UTILIZATION PROGRAM WHICH CANNOT BE MITIGATED OR AVOIDED.
DESCRIPTORS COST;ENVIRONMENTAL IMPACTS: Q1,Q2;GASEOUS WASTES;GOVERNMENT POLICIES;HEALTH HAZARDS;LIQUID WASTES;MANUFACTURING;NATIONAL PROGRAM PLANS;PHOTOVOLTAIC POWER PLANTS: T1;PHOTOVOLTAIC POWER SUPPLIES: T2;SAFETY;SILICON SOLAR CELLS;SOCIO-ECONOMIC FACTORS; SOLID WASTES

P-95

ACCESSION NO. 79R0092855
TITLE(MONO) MODULE/ARRAY INTERFACE STUDY. FINAL REPORT
CORPORATE AUTH BECHTEL NATIONAL, INC., SAN FRANCISCO, CA (USA)
PAGE NO 227
AVAILABILITY DEP. NTIS, PC A11/MF A01.
DATE AUG 1978
CATEGORIES EDB-140600;140501
PRIMARY CAT EDB-140600
REPORT NO DOE/JPL/954698--1A
ABSTRACT BECHTEL NATIONAL, INC. HAS CONDUCTED A STUDY OF ALTERNATE MODULE, PANEL, AND ARRAY DESIGNS FOR USE IN LARGE SCALE APPLICATIONS SUCH AS CENTRAL STATION PHOTOVOLTAIC POWER PLANTS. THE OBJECTIVE OF THE STUDY IS TO IDENTIFY DESIGN FEATURES THAT WILL LEAD TO MINIMUM PLANT COSTS. SEVERAL ASPECTS OF MODULE DESIGN ARE EVALUATED, INCLUDING GLASS SUPERSTRATE AND METAL SUBSTRATE MODULE CONFIGURATIONS, THE POTENTIAL FOR HAIL DAMAGE, LIGHT ABSORPTION IN GLASS SUPERSTRATES, THE ECONOMICS OF GLASS SELECTION, AND ELECTRICAL DESIGN. ALSO, THREE ALTERNATE GLASS SUPERSTRATE MODULE CONFIGURATIONS ARE EVALUATED BY MEANS OF FINITE ELEMENT COMPUTER ANALYSES. TWO PANEL SIZES, 1.2 BY 2.4 M (4 BY 8 FT) AND 2.4 BY 4.8 M (8 BY 16 FT), ARE USED TO SUPPORT THREE MODULE SIZES, 0.6 BY 1.2 M (2 BY 4 FT), 1.2 BY 1.2 M (4 BY 4 FT), AND 1.2 BY 2.4 M (4 BY 8 FT). FOR DESIGN LOADINGS OF +- 1.7 KPA (35 PSF), +- 2.4 KPA (50 PSF), AND +- 3.6 KPA (75 PSF). DESIGNS AND COST ESTIMATES ARE PRESENTED FOR TWENTY PANEL TYPES AND NINE ARRAY CONFIGURATIONS AT EACH OF THE THREE DESIGN LOADINGS. STRUCTURAL COST SENSITIVITIES OF COMBINED ARRAY CONFIGURATIONS AND PANEL CASES ARE PRESENTED.
DESCRIPTORS ADHESIVES;BREAKDOWN;COMPUTER CALCULATIONS;CONNECTORS;COST: Q1,Q2;COVERINGS;DESIGN: Q1,Q2;ECONOMICS;ELECTRICAL INSULATION; ENCAPSULATION;GLASS;HAIL;INVERTERS;LEAKAGE CURRENT;OPTICAL PROPERTIES;PERFORMANCE;PHOTOVOLTAIC POWER PLANTS: T1;POTTING MATERIALS;SIZE;SOLAR CELL ARRAYS: T2;SUBSTRATES;SUPPORTS; TENSILE PROPERTIES

P-96

ACCESSION NO. 79R0067318
TITLE(MONO) TERRESTRIAL CENTRAL STATION ARRAY LIFE-CYCLE ANALYSIS SUPPORT STUDY. FINAL REPORT
CORPORATE AUTH BECHTEL CORP., SAN FRANCISCO, CA (USA)
PAGE NO 211
AVAILABILITY NTIS PC A10/MF A01.
CONTRACT NO CONTRACT JPL-954846
DATE AUG 1978
CATEGORIES EDB-140501;140600
PRIMARY CAT EDB-140501
REPORT NO N--78-33534
ABSTRACT PLANT ELEMENTS EVALUATED INCLUDED DESIGNS FOR MODULE, PANEL AND ARRAY STRUCTURES, AS WELL AS BALANCE-OF-PLANT SYSTEMS. INSTALLATION AND MAINTENANCE PROCEDURES AND THE IMPACT OF SITE ENVIRONMENT WERE ALSO EVALUATED. IN TERMS OF THE COST OF ENERGY PRODUCED, THE HORIZONTAL ARRAY CONFIGURATION WAS FOUND TO BE LESS EXPENSIVE THAN THE TANDEM ARRAY AT LATITUDES LESS THAN 40 DEG. BOTH OF THESE CONFIGURATIONS ARE LESS EXPENSIVE THAN THE RACK DESIGN. HOWEVER, THE COSTS OF ENERGY FOR ALL THREE CONFIGURATIONS ARE WITHIN APPROXIMATELY 10 PERCENT OF EACH OTHER. FOR FLAT PLATE PANELS, THE SEASONALLY ADJUSTED AND TRACKING ARRAY CONFIGURATIONS ARE NOT ECONOMICALLY ATTRACTIVE WHEN COMPARED TO THE THREE OTHER DESIGNS. BALANCE-OF-PLANT COSTS ARE APPROXIMATELY EQUAL TO (GOAL) MODULE COSTS. THE ARRAY STRUCTURES AND FOUNDATIONS ARE THE MOST EXPENSIVE ITEMS IN THE BALANCE-OF-PLANT COSTS.
DESCRIPTORS DESIGN: Q1,Q2;EVALUATION;INSTALLATION;LIFE-CYCLE COST: Q1,Q2; MAINTENANCE;PHOTOVOLTAIC POWER PLANTS: T2;SOLAR CELL ARRAYS: T1

P-97

ACCESSION NO.	79X0067298
TITLE(MONO)	LSA LOW-COST SOLAR ARRAY PROJECT. PROJECT QUARTERLY REPORT NO. 6, JULY--SEPTEMBER 1977
CORPORATE AUTH	JET PROPULSION LAB., PASADENA, CA (USA)
SEC REPT NO	JPL-PUBL--78-83
PAGE NO	135
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1012
DATE	1977
CATEGORIES	EDB-140501;300601
PRIMARY CAT	EDB-140501
REPORT NO	DOE/JPL/1012--76/2
ABSTRACT	THE ACTIVITIES OF THE LOW-COST SILICON SOLAR ARRAY PROJECT DURING THE PERIOD JULY THROUGH SEPTEMBER, 1977, ARE DESCRIBED. THE LSSA PROJECT IS ASSIGNED RESPONSIBILITY FOR ADVANCING SILICON SOLAR ARRAY TECHNOLOGY WHILE ENCOURAGING INDUSTRY TO REDUCE THE PRICE OF ARRAYS TO A LEVEL AT WHICH PHOTOVOLTAIC ELECTRIC POWER SYSTEMS WILL BE COMPETITIVE WITH MORE CONVENTIONAL POWER SOURCES EARLY IN THE NEXT DECADE. SET FORTH HERE ARE THE GOALS AND PLANS WITH WHICH THE PROJECT INTENDS TO ACCOMPLISH THIS, AND THE PROGRESS THAT WAS MADE DURING THE QUARTER. THE PROJECT OBJECTIVE IS TO DEVELOP THE NATIONAL CAPABILITY TO PRODUCE LOW-COST, LONG-LIFE PHOTOVOLTAIC ARRAYS AT A RATE GREATER THAN 500 MEGAWATTS PER YEAR AND A PRICE OF LESS THAN $500 PER KILOWATT PEAK BY 1986. THE ARRAY PERFORMANCE GOALS INCLUDE AN EFFICIENCY GREATER THAN 10% AND AN OPERATING LIFETIME IN EXCESS OF 20 YEARS.
DESCRIPTORS	CASTING;CONTRACTS;COST;COST BENEFIT ANALYSIS;CRYSTAL GROWTH; CUTTING;ECONOMIC ANALYSIS;EFFICIENCY;ELECTRICAL PROPERTIES; ENCAPSULATION;FABRICATION;FAILURES;MANUFACTURING;OPTIMIZATION; PERFORMANCE TESTING;POLYMERS;PRODUCTION: Q1,Q2;RESEARCH PROGRAMS;SILICON SOLAR CELLS: T1;SOLAR CELL ARRAYS: T2; TEMPERATURE DEPENDENCE

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ACCESSION NO.	79C0061240
TITLE	LIFETIME COST AND PERFORMANCE MODEL FOR PHOTOVOLTAIC POWER SYSTEMS
AUTHORS	BORDEN, C.S.
AUTHOR AFF	CALIF INST OF TECHNOL, JPL, PASADENA
TITLE(MONO)	IEEE PHOTOVOLTAIC SPECIALIST CONFERENCE
SEC REPT NO	CONF-780619--
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CONF PLACE	WASHINGTON, DC, USA
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PUBL LOC	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC., NEW YORK, NY
DATE	1978
CATEGORIES	EDB-140600
PRIMARY CAT	EDB-140600
AUGMENTATION	DOE
ABSTRACT	A MODEL WHICH DESCRIBES A RIGOROUS APPROACH FOR ESTIMATING THE IMPACT OF ALTERNATIVE INITIAL DESIGNS AND RECURRENT POLICIES ON SYSTEM COST AND ENERGY OUTPUT IS PRESENTED. PARTICULAR EMPHASIS IS PLACED ON DERIVING THE EFFECT ON POWER GENERATION DUE TO HOURLY WEATHER CONDITIONS, CLEANING FREQUENCY, AND REPLACEMENT POLICY. THIS MODEL SEEKS TO PROVIDE A STRUCTURE FOR EVALUATING LIFETIME COSTS AND PERFORMANCE WITH THE SAME ANALYTICAL RIGOR AS MODELS CURRENTLY AVAILABLE FOR CALCULATING SYSTEM FIRST COSTS.
DESCRIPTORS	COST;DESIGN;ECONOMIC ANALYSIS: Q1,Q2;OPTIMIZATION;PERFORMANCE; PHOTOVOLTAIC POWER PLANTS: T1;PHOTOVOLTAIC POWER SUPPLIES: T2; SERVICE LIFE

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P.103 A Photoltaic Flat-Panel System for Process Power in Battery Manufacture (ALO-71).

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P.108 A 20-kW Photovoltaic Flat-Panel Power System for an Uninterruptible Power Supply Load in El Paso, Texas (ALO-71).

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WIND TURBINE ENERGY CONVERSION SYSTEMS

Analysis

Availability of information characterizing parameters of wind turbine energy conversion systems is summarized in Table 54. Data used in the analysis of perameters for which information is available are presented in Table 55.

Applying appropriate data analysis techniques resulted in the following functions for these parameters.

Efficiency of Horizontal Axis Wind Turbine Energy Conversion Systems (WTHEF)

$$\text{WTHEF}\ (\%) = 10.526\ x^{(0.16860)} \tag{31}$$

Standard Deviation = 25.46

x = kW

Equation 31 and corresponding data are shown in Figure 28.

Efficiency of Vertical Axis Wind Turbine Energy Conversion Systems (WTVEF)

$$\text{WTVEF}\ (\%) = 12.921/\log_{10}\ (x + 1) \tag{32}$$

Standard Deviation = 0.427

x = kW

Equation 32 and corresponding data are shown in Figure 29.

Efficiency of Vertical Axis Giromill Wind Turbine Energy Conversion Systems (WTVGE)

$$\text{WTVGE}\ (\%) = 7.880 + 7.728\ (\log_{10}\ x) \tag{33}$$

Standard Deviation = 5.967

x = kW

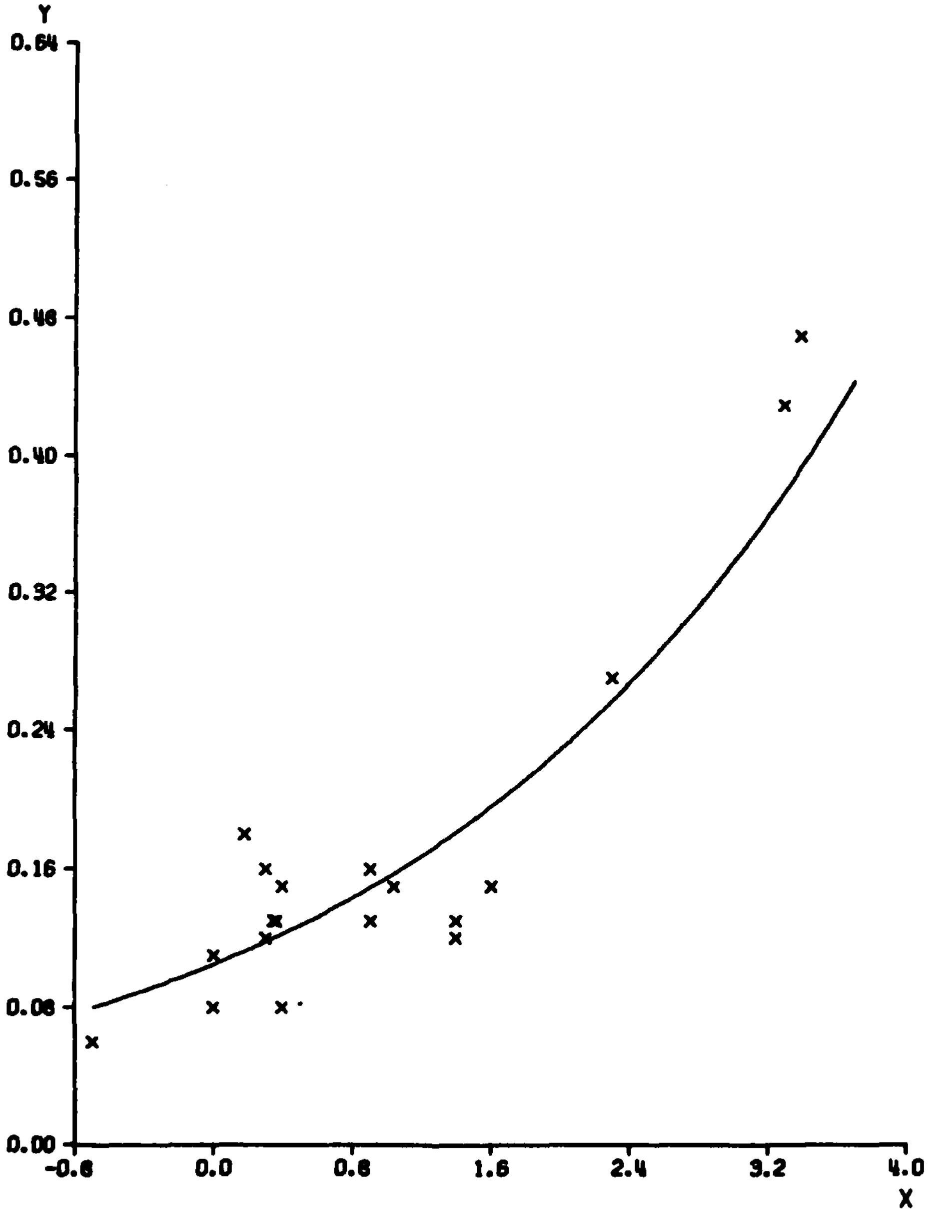
WTVGE data are limited, and there is considerable scatter of data values. Equation 33 and corresponding data are shown in Figure 30.

Table 54. AVAILABILITY OF INFORMATION CHARACTERIZING PARAMETERS OF WIND TURBINE ENERGY CONVERSION SYSTEMS

Parameter	Horizontal Axis Wind Turbine	Vertical Axis Wind Turbine
	Data Availability	Data Availability
Efficiency	Yes	Yes
Acquisition Cost	Yes	No
Operation and Maintenance Cost	No	No
Life Cycle Cost	No	No
Weight	Yes	No
Volume	No	No
Size	Yes	No
Start-Up/Shutdown Time	No	No
Lifetime	No	No

Table 55. DATA USED IN ANALYSIS OF PARAMETERS OF EFFICIENCY, SIZE, ACQUISITION COST, AND WEIGHT OF WIND TURBINE ENERGY CONVERSION SYSTEMS

Size (kW)	Efficiency-Horizontal Axis Wind Turbine (Fractional)	Efficiency-Vertical Axis Wind Turbine (Fractional)	Efficiency-Vertical Axis Giromill (Fractional)	Size/Rotor-Diameter-Horizontal Axis Wind Tubrine (ft)	Acquisition-Cost Horizontal Axis Wind Turbine ($/kW)	Weight Horizontal Axis Wind Turbine (lb/kW)
0.2	0.06			6.0		
1.0	0.11		0.10	8.5	5000	
1.0	0.11			12.0		
1.0	0.08					
1.5	0.18			8.0	4000	
1.5	0.18					
2.0	0.12			12.0	2600	1000
2.0	0.12				3600	
2.0	0.16					
2.2	0.13					
2.3	0.13					
2.3	0.13					
2.5	0.08			8.0	2480	
2.5	0.15					
3.0				14.0	2330	
4.0		0.19				
4.0		0.18				
6.0		0.15				
8.0	0.16		0.10	31.0	1250	
8.0	0.13					
11.0	0.15	0.12				
15.0					800	
25.0	0.13			40.0		160
25.0	0.12				912	
40.0	0.15		0.23	64.0		
100.0		0.07				
200.0	0.27			125.0		445
2000.0	0.43			200.0	1039	160
2500.0	0.47			300.0	1550.8	250



Y = FRACTIONAL EFFICIENCY X = LOG (SIZE), KW

Figure 28. EFFICIENCY OF HORIZONTAL AXIS WIND TURBINE ENERGY CONVERSION SYSTEMS

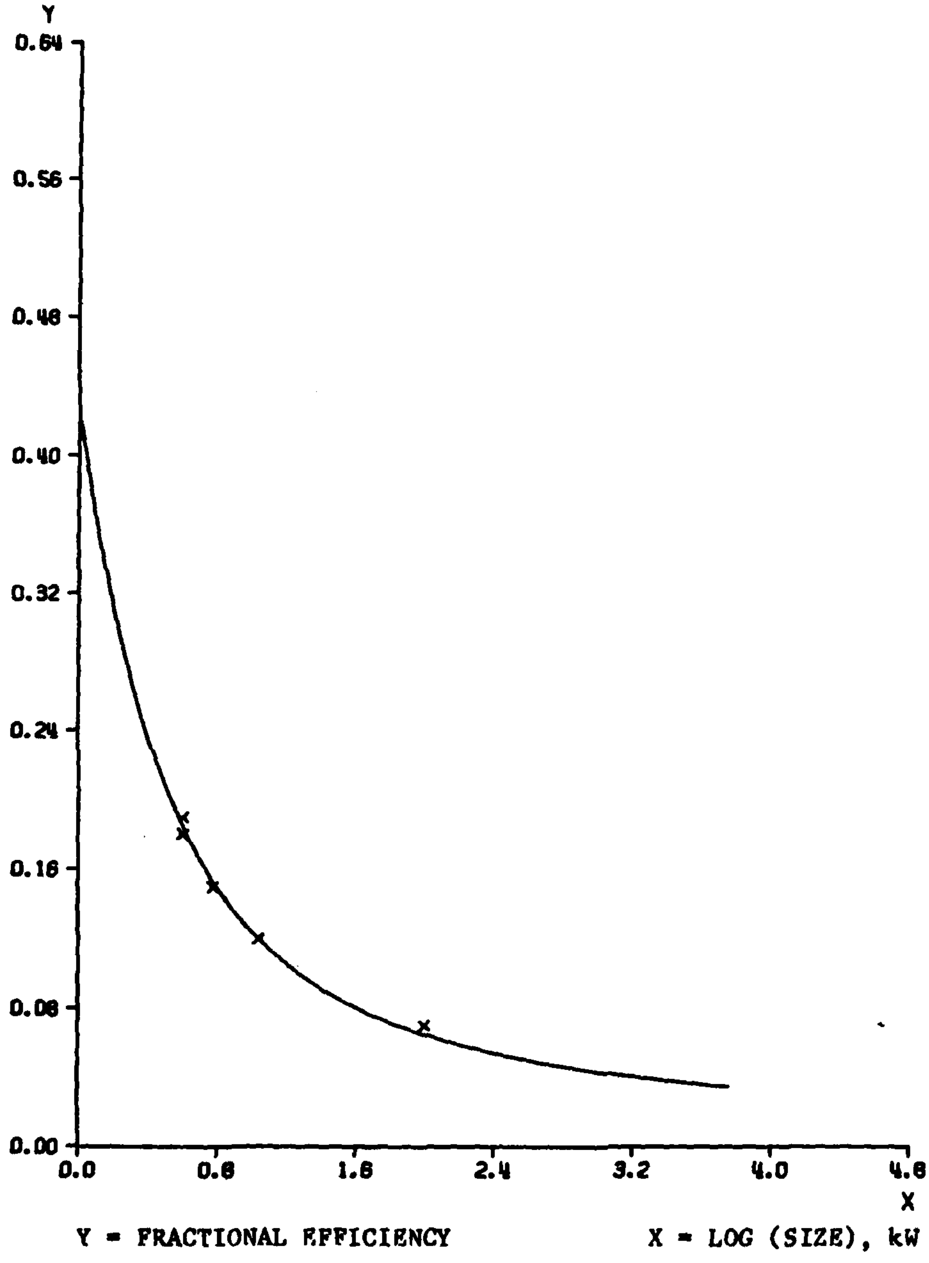


Figure 29. EFFICIENCY OF VERTICAL AXIS WIND TURBINE ENERGY CONVERSION SYSTEMS

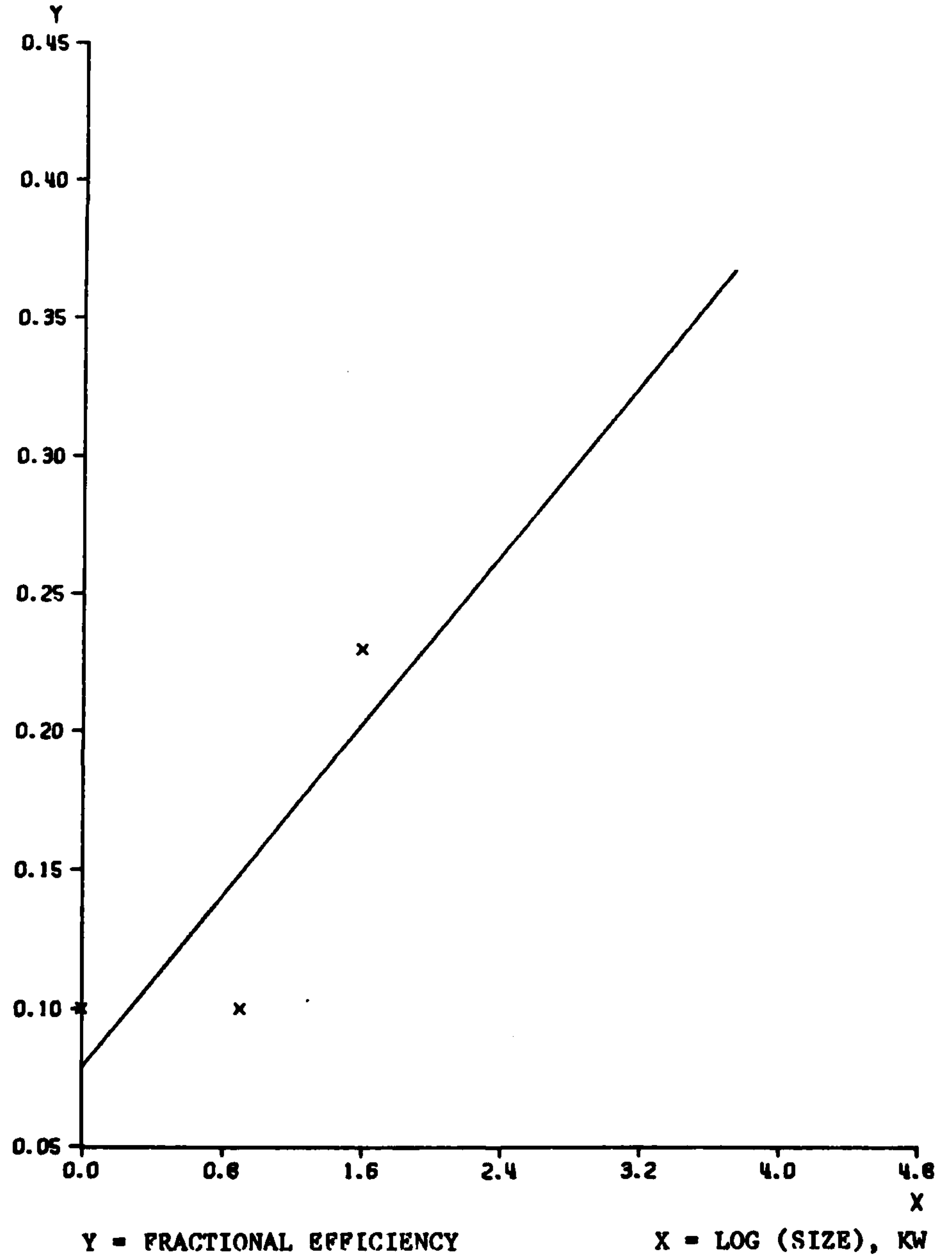


Figure 30. EFFICIENCY OF VERTICAL AXIS GIROMILL WIND TURBINE ENERGY CONVERSION SYSTEMS

Acquisition Cost of Horizontal Axis Wind Turbine Energy Conversion Systems (WTHAQ)

$$WTHAQ\ (\$/kW) = 1481.92390/\log_{10}(x + 1) \quad (34)$$

Standard Deviation = 50.44

x = kW

Data at sizes of 2000 and 2500 kW are anomalous. Values are too costly because they are experimental wind turbines developed by NASA and DOE rather than commercial wind turbines such as the systems under 25 kW in size. Dropping the two anomalous points results in Equation 35.

$$WTHAQ\ (\$/kW) = 4602.335353\ x^{-0.579435217} \quad (35)$$

Equation 35 is the preferred function for WTHAQ. However, large wind turbines over 25 kW in capacity are not currently commercially available. At a result, wind turbine acquisition costs above 25 kW as predicted by Equation 35 must be used with caution in design. For comparing energy conversion systems, an acquisition cost of $430/kW is suggested for wind turbines larger than 60 kW.

Weight of Horizontal Axis Wind Turbine Energy Conversion Systms (WTHWT)

$$WTHWT\ (lb/kW) = 479.6896/\log_{10}(x + 1) \quad (36)$$

Standard Deviation = 158.3

x = kW

Above 750 kW, negative standard deviation values lead to meaningless negative values for WTHWT. Above 750 kW use positive standard deviation values. Equation 36 and corresponding data are shown in Figure 31.

Size of Horizontal Axis Wind Turbine Energy Conversion Systems (WTHS)

$$WTHS\ (Rotor\ Diameter,\ ft) = 9.35716\ x^{0.44024} \quad (37)$$

Standard Deviation = 0.2853

x = kW

Equation 37 and corresponding data are shown in Figure 32. Values of the wind turbine energy conversion system parameters for selected system sizes (kW) as predicted from Equations 31 through 37 are presented in Table 56.

AD-A133 514 USAF ADVANCED TERRESTRIAL ENERGY STUDY VOLUME 4 6/8
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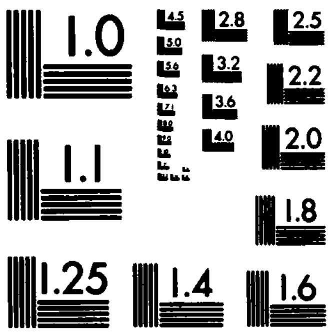
TECHNOLOGY CHICAGO ILL E J DANIELS ET AL. APR 83 61045
UNCLASSIFIED AFWAL-TR-82-2019-VOL-4 F33615-80-C-2041 F/G 10/1 NL


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

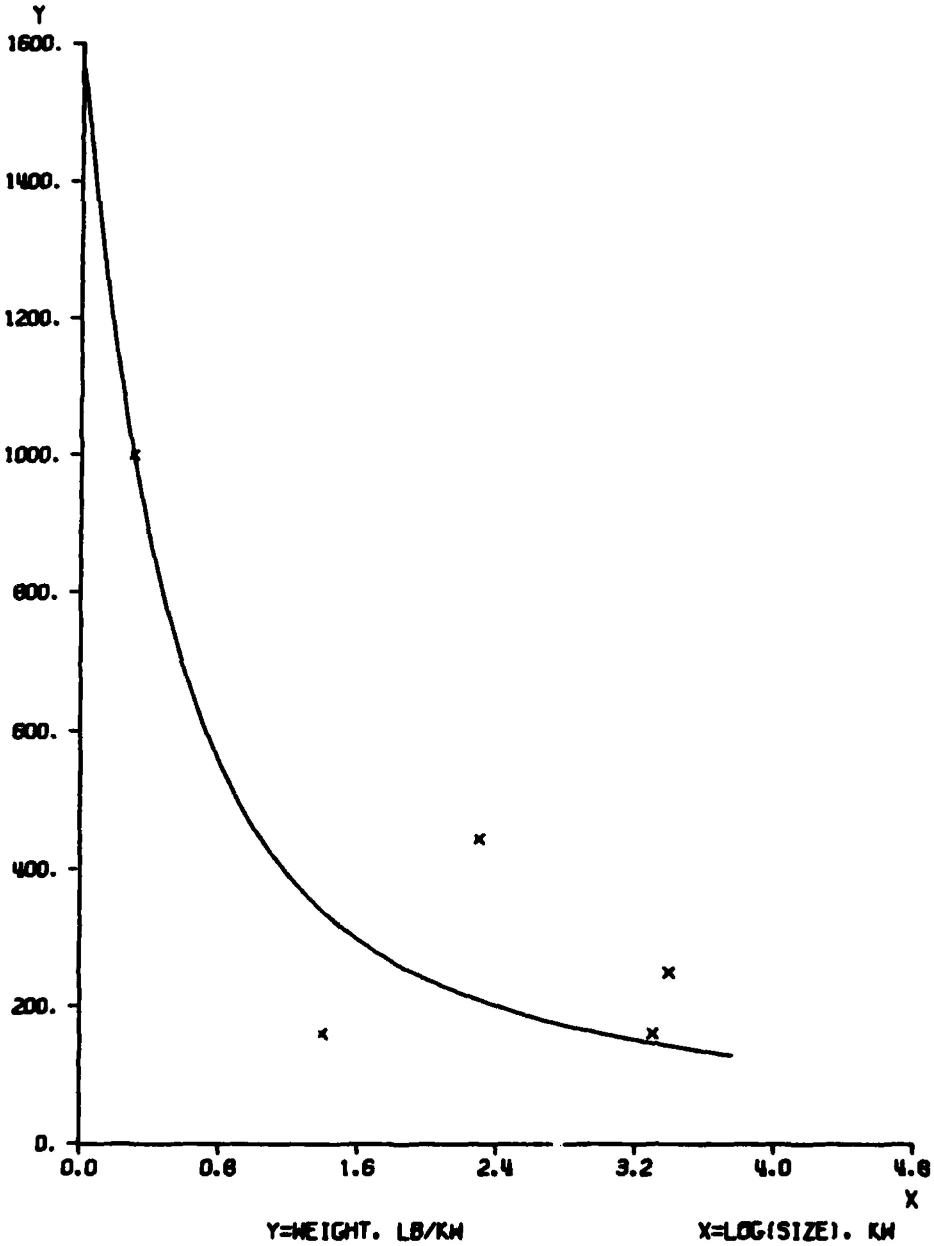


Figure 31. WEIGHT OF HORIZONTAL AXIS WIND TURBINE ENERGY CONVERSION SYSTEMS

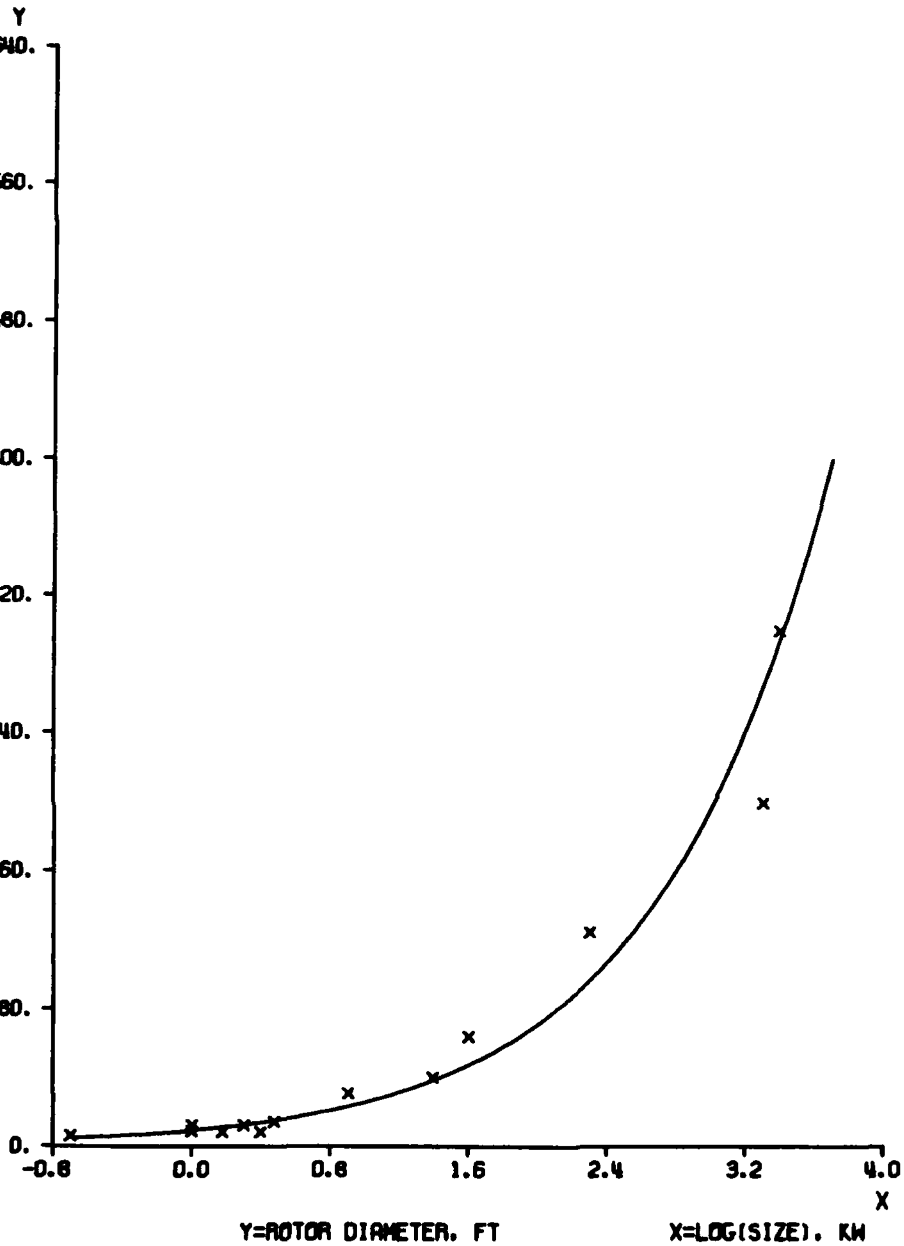


Figure 32. SIZE OF HORIZONTAL AXIS WIND TURBINE ENERGY CONVERSION SYSTEMS

Table 56. VALUES OF THE WIND TURBINE ENERGY CONVERSION SYSTEM PARAMETERS FOR EFFICIENCY, ACQUISITION COST, WEIGHT, AND SIZE AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

Size (kW)	(Equation 31) Efficiency-Horizontal Axis Wind Turbine (%)	(Equation 32) Efficiency-Vertical Axis Wind Turbine (%)	(Equation 33) Efficiency-Vertical Axis Giromill (%)	(Equation 35) Acquisition Cost Horizontal Axis Wind Turbine ($/kW)	(Equation 36) Weight-Horizontal Axis Wind Turbine (lb/kW)	(Equation 37) Size/Rotor Diameter-Horizontal Axis Wind Turbine (ft)
1.5	11.3	32.5	9	3640	1210	11
5.0	13.8	16.6	13	1810	620	19
20.0	17.4	9.8	18	810	360	35
30.0	18.7	8.7	19	640	320	42
60.0	21.0	7.2	22	430	270	57
100.0	22.9	6.4	23	320*	240	71
250.0	26.7	5.4	26	190	200	106
750.0	32.1	4.5	30	100	170	173
1000	33.7	4.3	31	80	160	196
5000	44.2	3.5	37	30	130	398
10000	49.7	3.2	39	20	120	540

* Use $430/kW for units larger than 60 kW.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 57, 58, 59, and 60, respectively.

Table 57. WIND TURBINE ENERGY CONVERSION SYSTEM
LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirements	0	Dionized/distilled water required for battery maintenance
2. Manning Requirements	0	Can operate unattended. Requires nominal inspection and maintenance.
3. Fuel Availability and Delivery	●	Fuel not required unless back-up system is used.
4. Fuel Storage	0	Only as required by back-up system
5. Other	●	Wind availability is a major constraint

Overall Assessment: The ordinal score is 3 indicating average locational constraints.

Table 58. WIND TURBINE ENERGY CONVERSION SYSTEM
OPERATIONAL CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability	●	Moderate constraint. Part-load efficiency less than full-load efficiency because of input/output ineffeciencies of battery storage.
2. Overload Capability	●	No overload capability
3. Load Following Capacity	0	

Overall Assessment: The ordinal score is 2 indicating turn-down capability with high efficiency penalty.

Table 59. RELIABILITY OF WIND TURBINE ENERGY CONVERSION SYSTEM

Constraint	Effect	Remarks
1. Moving Parts	●	Large mass moving parts
2. Operating Temperature	—	
3. Modularity of the Design	0	
4. Stress Levels	●	Large stresses at high wind speeds
5. Corrosion	0	
6. Other	●	Wind systems are highly interactive with wind availability

Overall Assessment: The ordinal score is 2 indicating moderate potential unreliability.

Table 60. WIND TURBINE ENERGY CONVERSION SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	—	—	—	
• Air Pollution				
CO	—	—	—	
NO_x	—	—	—	
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Others	—	—	—	
• Noise	⊖	○	⊖	Low-frequency tones
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

WIND TURBINE ENERGY CONVERSION SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Wind Turbine-Horizontal Axis

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
W. 53		0.11	1.0	
W. 42		0.11	1.0	
W. 53		0.18	1.5	
W. 42		0.18	1.5	
W. 53		0.08	2.5	
W. 53		0 15	2.5	
W. 53		0.12	2.0	
W. 10		0.13	2.3	
W. 13		0.13	2.3	
W. 10		0.16	8.0	
W. 12		0.13	8.0	
W. 53		0.12	2.0	
W. 53		0.16	2.0	
W. 53		0.08	1.0	
W. 53		0.06	0.2	
W. 18		0.13	25.0	
W. 18		0.15	11.0	
W. 53		0.24	3.0	
W. 18	0.15		40.0	
W. 21	0.43		2000	
W. 21	0.47		2500	
W. 21	0.27		200	

DATA SHEET

Energy Conversion System: Wind Turbine-Horizontal Axis

Parameter: Efficiency (continued)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
W. 55		0.13	2.2	
W. 55		0.12	25.0	

DATA SHEET

Energy Conversion System: Wind Turbine-Horizontal Axis

Parameter: Volume/Size (Rotor Diameter-Ft)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
W. 53		8.5	1.0	
W. 53		8.0	1.5 & 2.5	
W. 53		12.0	2.0	
W. 53		14.0	3.0	
W. 53		12.0	1.0	
W. 53		6.0	0.2	
W. 12		31.0	8.0	
W. 55		40.0	25.0	
W. 18		64.0	40.0	
W. 21	125		200	
W. 21	200		2000	
W. 21	300		2500	

DATA SHEET

Energy Conversion System: Wind Turbine-Horizontal Axis

Parameter: Weight (with tower), Lbs

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
W. 55		4000	25	
W. 21		89,000	200	
W. 21	320,000		2000	
W. 21	625,000		2500	
W. 55		2000	2	

DATA SHEET

Energy Conversion System: Wind Turbine-Horizontal Axis

Parameter: Start-up/Shutdown Time

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
W. 1 - W. 52		½ sec.		

DATA SHEET

Energy Conversion System: Wind Turbine-Horizontal Axis

Parameter: O&M Cost

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
W. 1 - W.52	1-2% of acquisition cost/year			

DATA SHEET

Energy Conversion System: Wind Turbine-Horizontal Axis

Parameter: Lifetime (yrs)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Frequency Of Operation	Assumptions of Advanced State of the Art
W. 1 - W. 52	25-30		1-2500 Kw	

DATA SHEET

Energy Conversion System: Wind Turbine-Horizontal Axis*

Parameter: Acquisition Cost (In 1980 dollars)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
W. 41	3,877,000		2500	
	2,078,000		2000	
	1,250,000		200	
W. 53		5200.	2.0	
W. 53		7200.	2.0	
W. 55		22,800.	25.0	
W. 10	10,000		8.0	
W. 53		5000.	1.0	
W. 53		12,000.	15.0	
W. 53		6000.	1.5	
W. 53		6200.	2.5	
W. 53		7000.	3.0	

*including tower

DATA SHEET

Energy Conversion System: Wind Turbine-Vertical Axis

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
W. 53		.19	4.0	Cyclo turbine
W. 53		.18	4.0	
W. 53		.15	6.0	
W. 18	.12		11.0	
W. 18	.07		100	
W. 18	.23		40	Giromill
W. 18	.10		1.0	
W. 18	.10		8.0	

WIND TURBINE ENERGY CONVERSION SYSTEMS

Bibliography

W-1	ACCESSION NO.	80R0076825
	TITLE(MONO)	SUMMARY OF GUIDELINES FOR SITING WIND TURBINE GENERATORS RELATIVE TO SMALL-SCALE, TWO-DIMENSIONAL TERRAIN FEATURES. FINAL REPORT
	EDITOR OR COMP	FROST, W.; NOWAK, D.K.
	CORPORATE AUTH	FWG ASSOCIATES, INC., TULLAHOMA, TN (USA)
	PAGE NO	395
	AVAILABILITY	NTIS, PC A17/MF A01.
	CONTRACT NO	CONTRACT AC06-77ET20242
	DATE	MAR 1979
	CATEGORIES	EDB-170604
	PRIMARY CAT	EDB-170604
	REPORT NO	RLO--2443-77/1
	ABSTRACT	A SUMMARY OF A DETAILED USERS' MANUAL ON SITING WIND TURBINE GENERATORS (WTG'S) RELATIVE TO SMALL-SCALE, TWO-DIMENSIONAL, TERRAIN FEATURES IS GIVEN. THE TERRAIN FEATRUES CONSIDERED ARE ONE OR MORE SURFACE ROUGHNESS CHANGES ON OTHERWISE FLAT TERRAIN, SHELTERBELTS OR WINDBREAKS, AND BLUFF AND SMOOTH CONTOURED HILLS. ESTIMATES ARE GIVEN OF THE PREFERRED WTG LOCATION RELATIVE TO THESE TERRAIN FEATURES AND OF THE RESULTING DEGRADATION IN AVAILABLE WIND POWER DUE TO LOCATING THE WTG OTHER THAN AT THE PREFERRED SITE. THE SITING CRITERIA ARE BASED ON FLUID MECHANICS ANALYSES OF SOMEWHAT IDEALIZED TERRAIN GEOMETRIES AND PREVAILING ATMOSPHERIC CONDITIONS. THEREFORE, THE RESULTS PRESENTED SHOW TRENDS AND ORDER OF MAGNITUDE EFFECTS RATHER THAN ABSOLUTE VALUES. THE THEORETICAL APPROACH TO ANALYZING THE FLOW FIELD AND THE RELIABILITY OF THE ANALYTICAL ASSUMPTIONS FOR EACH TERRAIN FEATURE CONSIDERED ARE DISCUSSED IN THEIR RESPECTIVE SECTIONS.
	DESCRIPTORS	METEOROLOGY;RECOMMENDATIONS;SITE SELECTION: Q1;TOPOGRAPHY;WIND; WIND TURBINES: T1

W-2	ACCESSION NO.	80R0076824
	TITLE(MONO)	SITES FOR WIND POWER INSTALLATIONS: PHYSICAL MODELING OF THE INFLUENCE OF HILLS RIDGES AND COMPLEX TERRAIN ON WIND SPEED AND TURBULENCE
	EDITOR OR COMP	MERONEY, R.N.; SANDBORN, V.A.
	CORPORATE AUTH	COLORADO STATE UNIV., FORT COLLINS (USA). DEPT. OF CIVIL ENGINEERING
	PAGE NO	211
	AVAILABILITY	NTIS, PC A10/MF A01.
	CONTRACT NO	CONTRACT EY-77-S-06-2438
	DATE	JUN 1978
	CATEGORIES	EDB-170604
	PRIMARY CAT	EDB-170604
	REPORT NO	RLO--2438-78/3
	ABSTRACT	A SYSTEMATIC WIND-TUNNEL STUDY OF FLOW OVER TWO-DIMENSIONAL HILLS WAS MADE. THE FLOW OVER SIX DIFFERENT TWO-DIMENSIONAL HILLS WAS EVALUATED FOR IDENTICAL APPROACH CONDITIONS. THE RESULTS INDICATED THAT THE TRIANGULAR AND SINUSOIDAL HILLS PRODUCED THE GREATEST SPEEDUP OF THE AIRSTREAM IN THE REGION NEAR THE SURFACE. THE MORE ABRUPT MODELS PRODUCED LESS OF AN INCREASE IN LOCAL VELOCITY.
	DESCRIPTORS	DATA COMPILATION;SIMULATION;SITE SELECTION: Q2;TEST FACILITIES; TOPOGRAPHY: Q1;WIND POWER: T1;WIND TUNNELS;WIND TURBINES: T2

W-3	ACCESSION NO.	80R0076823
	TITLE(MONO)	SITES FOR WIND-POWER INSTALLATIONS: WIND CHARACTERISTICS OVER RIDGES. PART II. FINAL REPORT
	EDITOR OR COMP	BOUWMEESTER, R.J.B.; MERONEY, R.N.; SANDBORN, V.A.
	CORPORATE AUTH	COLORADO STATE UNIV., FORT COLLINS (USA). DEPT. OF CIVIL ENGINEERING
	PAGE NO	122
	AVAILABILITY	NTIS, PC A06/MF A01.
	CONTRACT NO	CONTRACT EY-77-S-06-2438
	DATE	JUN 1978
	CATEGORIES	EDB-170604
	PRIMARY CAT	EDB-170604
	REPORT NO	RLO--2438-78/2
	ABSTRACT	THE PURPOSE OF THIS RESEARCH WAS TO INCREASE KNOWLEDGE OF THE PHYSICAL PROCESSES THAT GOVERN WIND CHARACTERISTICS OVER RIDGES AND, SUBSEQUENTLY, TO IMPROVE EMPIRICAL AND NUMERICAL FOR ESTIMATING WIND VELOCITIES OVER RIDGES. THESE OBJECTIVES WERE ACHIEVED BY CONDUCTING A WIND-TUNNEL STUDY OF THE FLOW FIELD OVER TRIANGULAR-SHAPED AND SINUSOIDAL-SHAPED RIDGE MODELS WITH VARYING UPWIND AND DOWNWIND SLOPES UNDER VARIOUS THERMAL STRATIFICATION CONDITIONS. A SIMPLE TECHNIQUE WAS DEVELOPED TO PREDICT THE VELOCITY-AMPLIFICATION PROFILE ABOVE A RIDGE CREST FOR AN ARBITRARY RIDGE SLOPE. LARGEST SPEEDUPS WERE MEASURED FOR THE STEEPEST SYMMETRICAL RIDGE WHICH DID NOT CAUSE FLOW SEPARATION. CRITERIA FOR FLOW SEPARATION OVER RIDGES ARE PROVIDED IN THIS REPORT. APPLICABILITY OF THE RESULTS FOR RIDGES WITH FINITE WIDTH IS DISCUSSED.
	DESCRIPTORS	SIMULATION;SITE SELECTION: Q2;TEST FACILITIES;TOPOGRAPHY: Q1; WIND POWER: T1;WIND TUNNELS;WIND TURBINES: T2

W-4

ACCESSION NO.	80R0076817
TITLE (MONO)	LARGE WIND TURBINE GENERATOR PERFORMANCE ASSESSMENT. TECHNOLOGY STATUS REPORT NO. 1
EDITOR OR COMP	VACHON, W.A.
CORPORATE AUTH	LITTLE (ARTHUR D.), INC., CAMBRIDGE, MA (USA)
PAGE NO	90
AVAILABILITY	NTIS, PC A05/MF A01.
DATE	JAN 1980
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	EPRI-AP--1317
ABSTRACT	THE RESULTS OF LARGE WIND TURBINE GENERATOR (WT) DEVELOPMENT AND FIELD TEST ACTIVITIES ARE PRESENTED. AN APPROACH FOR GATHERING, DISTILLING, AND ASSESSING WT TEST DATA IS PRESENTED, WITH EMPHASIS ON THE USEFULNESS OF THE DATA TO THE INDUSTRY. TEST RESULTS TO DATE HAVE VALIDATED THE DOE/NASA WT DESIGN PROCEDURES WHICH HAVE BEEN ESTABLISHED BY BOTH SUPPORTING RESEARCH AND TECHNOLOGY AND SOUND ENGINEERING PROGRAMS. THESE PROGRAMS HAVE EMPLOYED FIRST-GENERATION, HORIZONTAL AXIS WT'S IN RESEARCH AND OPERATION TESTS. COST OF ENERGY (COE) PROJECTIONS INDICATE THAT LATER GENERATION WT'S ARE LIKELY TO PROVIDE ELECTRICITY AT COMPETITIVE COSTS IN SOME UTILITY SYSTEMS WITHIN SEVERAL YEARS. SEVERAL PRIVATELY FUNDED HORIZONTAL AND VERTICAL-AXIS WT'S ARE PRESENTLY EITHER IN THE PLANNING OR CONSTRUCTION PHASE, OR ACTUALLY UNDER TEST IN UTILITY GRIDS. TEST RESULTS FROM THESE WT'S WILL BE PRESENTED IN FUTURE REPORTS.
DESCRIPTORS	DATA ANALYSIS;DATA COMPILATION;DEMONSTRATION PROGRAMS: 01,02; NASA;PERFORMANCE TESTING: 01,02;PLANNING;POWER RANGE 1-10 MW; POWER RANGE 100-1000 KW;US DOE;WIND POWER PLANTS: 11;WIND TURBINES: 12

W-5

ACCESSION NO.	80R0076816
TITLE (MONO)	MOD-2 WIND TURBINE SYSTEM CONCEPT AND PRELIMINARY DESIGN REPORT. VOLUME 1. EXECUTIVE SUMMARY
CORPORATE AUTH	BOEING ENGINEERING AND CONSTRUCTION CO., SEATTLE, WA (USA)
PAGE NO	32
AVAILABILITY	NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT AI01-79ET20305
DATE	JUL 1979
CATEGORIES	EDB-170602;170400
PRIMARY CAT	EDB-170602
REPORT NO	DOE/NASA/0002--80/2(VOL.1)
ABSTRACT	THE MOD-2 CONFIGURATION EVOLVED FROM EXTENSIVE TRADE STUDIES AND SENSITIVITY STUDIES COUPLED WITH INPUTS FROM NASA, SEVERAL UTILITIES, AND WITH THE RESULTS OF A FAILURE MODES AND EFFECTS ANALYSIS (FMEA). THE RESULTING SYSTEM IS OPTIMIZED FOR A MINIMUM COST OF ELECTRICITY WHILE MAINTAINING COMPATIBILITY WITH EXISTING UTILITY NETWORKS AND WHILE MEETING SAFETY REQUIREMENTS. A SYSTEM LIFE OF 30 YEARS WITH LOW ANNUAL OPERATIONS AND MAINTENANCE COSTS AS WELL AS LOW INITIAL COSTS WERE COUPLED WITH PERFORMANCE OPTIMIZATION TO ESTABLISH THE DESIGN WHICH ACHIEVES THE COE GOAL OF LESS THAN 4 CENTS PER KWH. THE DESIGN APPROACH IS ILLUSTRATED. THE GENERAL ARRANGEMENT AND CHARACTERISTICS OF THE MOD-3 SYSTEM ARE PRESENTED.
DESCRIPTORS	COST: 01;DEMONSTRATION PLANTS;NASA;POWER RANGE 1-10 MW; SPECIFICATIONS: 01;US DOE;WIND POWER PLANTS: 11;WIND TURBINES

W-6

ACCESSION NO.	80R0065429
TITLE (MONO)	SITING HANDBOOK FOR SMALL WIND ENERGY CONVERSION SYSTEMS
EDITOR OR COMP	WEGLEY, H.L.; RAMSDELL, J.V.; ORGILL, M.M.; DRAKE, R.L.
CORPORATE AUTH	BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA (USA)
PAGE NO	90
AVAILABILITY	DEP. NTIS, PC A05/MF A01.
CONTRACT NO	CONTRACT EY-76-C-06-1830
DATE	MAR 1980
CATEGORIES	EDB-170604
PRIMARY CAT	EDB-170604
REPORT NO	PNL--2521(REV.1)
ABSTRACT	THIS HANDBOOK WAS WRITTEN TO SERVE AS A SITING GUIDE FOR INDIVIDUALS WISHING TO INSTALL SMALL WIND ENERGY CONVERSION

	SYSTEMS (WECS); THAT IS, MACHINES HAVING A RATED CAPACITY OF LESS THAN 100 KILOWATTS. IT INCORPORATES HALF A CENTURY OF SITING EXPERIENCE GAINED BY WECS OWNERS AND MANUFACTURERS, AS WELL AS RECENTLY DEVELOPED SITING TECHNIQUES. THE USER NEEDS NO TECHNICAL BACKGROUND IN METEOROLOGY OR ENGINEERING TO UNDERSTAND AND APPLY THE SITING PRINCIPLES DISCUSSED; HE NEEDS ONLY A KNOWLEDGE OF BASIC ARITHMETIC AND THE ABILITY TO UNDERSTAND SIMPLE GRAPHS AND TABLES. BY PROPERLY USING THE SITING TECHNIQUES, AN OWNER CAN SELECT A SITE THAT WILL YIELD THE MOST POWER AT THE LEAST INSTALLATION COST, THE LEAST MAINTENANCE COST, AND THE LEAST RISK OF DAMAGE OR ACCIDENTAL INJURY.
DESCRIPTORS	AVAILABILITY;COST;FEASIBILITY STUDIES;METEOROLOGY;MONITORING; POWER GENERATION;SITE SELECTION: T,Q1;TOPOGRAPHY;WIND POWER; WIND TURBINES: T1

W-7

ACCESSION NO.	80C0065423
TITLE (MONO)	SCREENING METHOD FOR WIND ENERGY CONVERSION SYSTEMS
EDITOR OR COMP	MCCONNELL, R.D.
CORPORATE AUTH.	SOLAR ENERGY RESEARCH INST., GOLDEN, CO (USA)
SEC REPT NO	CONF-800604--19
PAGE NO	6
AVAILABILITY	NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EG-77-C-01-4042
CONF TITLE	AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY CONFERENCE
CONF PLACE	PHOENIX, AZ, USA
CONF DATE	2 JUN 1980
DATE	MAR 1980
CATEGORIES	EDB-170600
PRIMARY CAT	EDB-170400
REPORT NO	SERI/TP--731-649
ABSTRACT	A SCREENING METHOD IS PRESENTED FOR EVALUATING WIND ENERGY CONVERSION SYSTEMS (WECS) LOGICALLY AND CONSISTENTLY. IT IS A SET OF PROCEDURES SUPPORTED BY A DATA BASE FOR LARGE CONVENTIONAL WECS. THE PROCEDURES ARE FLEXIBLE ENOUGH TO ACCOMMODATE CONCEPTS LACKING COST AND ENGINEERING DETAIL, AS IS THE CASE WITH MANY INNOVATIVE WIND ENERGY CONVERSION SYSTEMS (IWECS). THE METHOD USES BOTH VALUE INDICATORS AND SIMPLIFIED COST ESTIMATING PROCEDURES. VALUE INDICATORS ARE SELECTED RATIOS OF ENGINEERING PARAMETERS INVOLVING ENERGY, MASS, AREA, AND POWER. COST MASS RATIOS AND COST ESTIMATING RELATIONSHIPS WERE DETERMINED FROM THE CONVENTIONAL WECS DATA BASE TO ESTIMATE OR VERIFY INSTALLATION COST ESTIMATES FOR IWECS. THESE VALUE INDICATORS AND COST ESTIMATING PROCEDURES ARE SHOWN FOR CONVENTIONAL WECS. AN APPLICATION OF THE METHOD TO A TRACKED-VEHICLE AIRFOIL CONCEPT IS PRESENTED.
DESCRIPTORS	COST;ECONOMICS: Q1;EFFICIENCY;FEASIBILITY STUDIES: Q1; PERFORMANCE;PLANNING;POWER GENERATION;WIND TURBINES: T1

W-8

ACCESSION NO.	80C0061657
REPORT NO.PAGE	RFP--3014(VOL.1 PP. 198-212
TITLE	SITING SMALL WIND MACHINES
AUTHORS	WEGLEY, H.L.; PENNELL, W.T.
AUTHOR AFF	BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA
TITLE(MONO)	SMALL WIND TURBINE SYSTEMS 1979. A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES. VOL. I. R AND D REQUIREMENTS
EDITOR OR COMP	DODGE, D.M.; STAFFORD, J.V. (EDS.
SEC REPT NO	CONF-790243--(VOL.1)
PAGE NO	198-212
AVAILABILITY	DEP. NTIS, PC A13/MF A01.
CONF TITLE	SWECS 1979: A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES
CONF PLACE	BOULDER, CO, USA
CONF DATE	20 FEB 1979
DATE	1979
CATEGORIES	EDB-170604
PRIMARY CAT	EDB-170604
REPORT NO	RFP--3014(VOL.1)
ABSTRACT	A RECENT SURVEY INDICATED THAT IMPROPER SITING WAS A COMMON CAUSE OF DISSATISFACTION AMONG SMALL WIND MACHINE USERS. MOST

POTENTIAL PURCHASERS WILL NEED TO BE REASONABLY CERTAIN OF THE COST OF WIND POWER FOR THEIR PARTICULAR APPLICATION BEFORE THEY DECIDE TO BUY A WIND ENERGY CONVERSION SYSTEM (WECS). SUCH AN ASSESSMENT REQUIRES AN ACCURATE KNOWLEDGE OF WIND CHARACTERISTICS AT THE MACHINE SITE. A PROCEDURE IS DESCRIBED FOR CHOOSING THE BEST AVAILABLE SITE FOR A WIND MACHINE AND FOR ESTIMATING THE PERTINENT WIND CHARACTERISTICS ONCE THE SITE IS CHOSEN. IN SOME CASES EXTENSIVE ONSITE MEASUREMENTS MAY BE REQUIRED BEFORE AN ACCURATE ANALYSIS OF MACHINE PERFORMANCE CAN BE MADE.

DESCRIPTORS	FORECASTING;PROSPECTING: Q2;SITE SELECTION: Q1;WIND POWER: T2; WIND TURBINES: T1

W-9

ACCESSION NO.	EDC0061025
REPORT NO.PAGE	RFP--3014(VOL.2 PP. 34-44
TITLE	DISTRIBUTION PLANNING PERSPECTIVE ON THE INTERCONNECTION OF SMALL WIND SYSTEMS WITH AN ELECTRIC UTILITY
AUTHORS	MA, F.S.
AUTHOR AFF	SYSTEMS CONTROL, INC., PALO ALTO, CA
TITLE(MONO)	SMALL WIND TURBINE SYSTEMS 1979. A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES. VOL. II. UTILITY INTERFACE/INSTITUTIONAL ISSUES
EDITOR OR COMP	DODGE, D.M.; STAFFORD, J.V. (EDS.
SEC REPT NO	CONF-790243--(VOL.2)
PAGE NO	34-44
AVAILABILITY	DEP. NTIS, PC A10/MF A01.
CONF TITLE	SWECS 1979: A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES
CONF PLACE	BOULDER, CO, USA
CONF DATE	20 FEB 1979
DATE	1979
CATEGORIES	EDB-170603
PRIMARY CAT	EDB-170603
REPORT NO	RFP--3014(VOL.2)
ABSTRACT	SMALL WIND ENERGY CONVERSION SYSTEMS (SWECS) INTERCONNECTED WITH A UTILITY GRID MAY SIGNIFICANTLY AFFECT THE NEED FOR TRANSMISSION AND DISTRIBUTION SYSTEMS INVESTMENT. THE STUDY OF THE INTERCONNECTION IMPACT ON UTILITY SYSTEMS IS NOT ONLY IMPORTANT TO THE UTILITY PLANNERS AND OPERATORS BUT ALSO CRUCIAL TO THE DEVELOPMENT OF EQUITABLE RATE STRUCTURES FOR SWECS USERS WHO MAY REQUIRE UTILITY BACKUP POWER. THE INTEGRATION PROBLEMS AND ISSUES FROM A DISTRIBUTION PLANNING PERSPECTIVE ARE DESCRIBED. A METHODOLOGY WAS DEVELOPED AND APPLIED ON DISTRIBUTION SYSTEMS IN AN EARLIER STUDY TO EVALUATE THE IMPACT OF DISPERSED STORAGE AND GENERATION (DSG) ON DISTRIBUTION SYSTEM PLANNING AND OPERATIONS.
DESCRIPTORS	ELECTRIC UTILITIES;FEASIBILITY STUDIES: Q2;INTERCONNECTED POWER SYSTEMS: T2,Q1;PLANNING;POWER TRANSMISSION;WIND TURBINES: T1

W-10

ACCESSION NO.	EDC0061021
REPORT NO.PAGE	RFP--3014(VOL.1 PP. 166-170
TITLE	ROCKY FLATS SUPPORTING RESEARCH AND TECHNOLOGY (SRT) PROGRAM
AUTHORS	SHEPHERD, D.G.
AUTHOR AFF	ROCKWELL INTERNATIONAL CORP., GOLDEN, CO
TITLE(MONO)	SMALL WIND TURBINE SYSTEMS 1979. A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES. VOL. I. R AND D REQUIREMENTS
EDITOR OR COMP	DODGE, D.M.; STAFFORD, J.V. (EDS.
SEC REPT NO	CONF-790243--(VOL.1)
PAGE NO	166-170
AVAILABILITY	DEP. NTIS, PC A13/MF A01.
CONF TITLE	SWECS 1979: A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES
CONF PLACE	BOULDER, CO, USA
CONF DATE	20 FEB 1979
DATE	1979
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	RFP--3014(VOL.1)
ABSTRACT	THE SUPPORTING RESEARCH AND TECHNOLOGY (SRT) TASK ELEMENT OF THE ROCKY FLATS WIND SYSTEMS PROGRAM ADDRESSES THE NEED FOR DEVELOPING TECHNOLOGY THAT WILL REDUCE SWECS COSTS AND IMPROVE

	SYSTEM RELIABILITY AND PERFORMANCE. THE FY 1979 ROCKY FLATS PROGRAM PLAN INCLUDES NINE SRT PROJECTS WHICH FOCUS ON THE DEVELOPMENT OF IMPROVED OR SIMPLIFIED ANALYTICAL TECHNIQUES AND THE DETERMINATION OF SPECIFIC COMPONENT PERFORMANCE DATA UNDER SPECIFIC CONDITIONS. A GENERAL STATEMENT FOR EACH PROJECT IS INCLUDED.
DESCRIPTORS	AERODYNAMICS;PERFORMANCE TESTING: G1;RESEARCH PROGRAMS: G1;WIND TURBINES: T1

W-11

ACCESSION NO.	80C0061016
REPORT NO.PAGE	RFP--3014(VOL.1 PP. 132-141
TITLE	40 KW GIROMILL PROGRAM
AUTHORS	DUBE, W.D.
AUTHOR AFF	VALLEY INDUSTRIES, INC., ST. LOUIS, MO
TITLE(MONO)	SMALL WIND TURBINE SYSTEMS 1979. A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES. VOL. 1. R AND D REQUIREMENTS
EDITOR OR COMP	DODGE, D.M.; STAFFORD, J.V. (EDS.
SEC REPT NO	CONF-790243--(VOL.1)
PAGE NO	132-141
AVAILABILITY	DEP. NTIS, PC A13/MF A01.
CONF TITLE	SWECS 1979: A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES
CONF PLACE	BOULDER, CO, USA
CONF DATE	20 FEB 1979
DATE	1979
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	RFP--3014(VOL.1)
ABSTRACT	ROCKWELL INTERNATIONAL HAS AWARDED THE MCDONNELL AIRCRAFT COMPANY A CONTRACT TO DESIGN, BUILD, AND DELIVER A 40 KW VERTICAL AXIS WINDMILL CALLED A GIROMILL. WORK BEGAN IN SEPTEMBER 1978. DELIVERY TO ROCKY FLATS IS SCHEDULED TOWARD THE END OF 1979. IN ORDER TO ACCOMPLISH THIS PROGRAM, A TEAMING ARRANGEMENT HAS BEEN MADE WITH THE VALLEY PUMP DIVISION OF VALLEY INDUSTRIES. VALLEY WILL PARTICIPATE IN THE DESIGN, WILL FABRICATE MOST OF THE PARTS, AND, IF THE MACHINE IS SUCCESSFUL, WILL MANUFACTURE AND MARKET THE WINDMILL UNDER A LICENSE AGREEMENT. DESIGN CHARACTERISTICS OF THE TURBINE ARE PRESENTED.
DESCRIPTORS	GIROMILL TURBINES: T1;SPECIFICATIONS: Q1

W-12

ACCESSION NO.	80C0061015
REPORT NO.PAGE	RFP--3014(VOL.1 PP. 76-105
TITLE	UTRC 8 KW WIND TURBINE
AUTHORS	CHENEY, M.C.
AUTHOR AFF	UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CT
TITLE(MONO)	SMALL WIND TURBINE SYSTEMS 1979. A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUE . VOL. 1. R AND D REQUIREMENTS
EDITOR OR COMP	DODGE, D.M.; STAFFORD, J.V. (EDS.
SEC REPT NO	CONF-790243--(VOL.1)
PAGE NO	76-105
AVAILABILITY	DEP. NTIS, PC A13/MF A01.
CONF TITLE	SWECS 1979: A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES
CONF PLACE	BOULDER, CO, USA
CONF DATE	20 FEB 1979
DATE	1979
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	RFP--3014(VOL.1)
ABSTRACT	THE CURRENT CONTRACT WITH ROCKWELL INTERNATIONAL IS TO FABRICATE A PROTOTYPE CBR WIND TURBINE WITH AN OUTPUT OF AT LEAST 8 KW IN A 9 M/S WIND. THIS CONTRACT WAS INITIATED IN OCTOBER 1977 AND CONTINUES INTO 1979 WITH THE DELIVERY AND EVALUATION OF THE SYSTEM AT ROCKY FLATS, COLORADO. THE OVERALL OBJECTIVES OF THE CONTRACT ARE TO DESIGN AND FABRICATE A SYSTEM IN THE 8 KW RANGE WHICH COULD BE PRODUCED IN HIGH QUANTITIES FOR NOT MORE THAN $750/KW, HAVE A USEFUL LIFE OF 25 YEARS, AND WITHSTAND SEVERE WEATHER CONDITIONS INCLUDING WIND SPEEDS UP TO 75 M/S. THE HIGHLIGHTS OF THE RESULTS TO DATE OF THIS CONTRACT ARE PRESENTED.

DESCRIPTORS CONTROL SYSTEMS;COST: Q1;MECHANICAL STRUCTURES;PERFORMANCE TESTING: Q1;POWER GENERATION;POWER RANGE 1-10 KW; SPECIFICATIONS: Q1;STRESS ANALYSIS;TURBINE BLADES;WIND TURBINES: T1

W-13

ACCESSION NO.	80C0001012
REPORT NO.PAGE	RFP--3014(VOL.1 PP. 13-30
TITLE	DEVELOPMENT OF A 2 KW HIGH-RELIABILITY WIND TURBINE GENERATOR
AUTHORS	DRAKE, W.; CLEWS, H.
AUTHOR AFF	ENERTECH CORP., NORWICH, VT
TITLE(MONO)	SMALL WIND TURBINE SYSTEMS 1979. A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES. VOL. 1. R AND D REQUIREMENTS
EDITOR OF COMP	JUDGE, D.M.; STAFFORD, J.V. (EDS.
SEC REPT NO	CONF-790243--(VOL.1)
PAGE NO	13-30
AVAILABILITY	DEP. NTIS, PC A13/MF A01.
CONF TITLE	SWECS 1979: A WORKSHOP ON R AND D REQUIREMENTS AND UTILITY INTERFACE/INSTITUTIONAL ISSUES
CONF PLACE	BOULDER, CO, USA
CONF DATE	20 FEB 1979
DATE	1979
CATEGORIES	EDB-170602;170400
PRIMARY CAT	EDB-170602
REPORT NO	RFP--3014(VOL.1)
ABSTRACT	ENERTECH CORPORATION IS CURRENTLY ENGAGED IN A PROGRAM TO DEVELOP AND FABRICATE PROTOTYPES FOR TESTING OF A 2 KW HIGH-RELIABILITY WIND TURBINE GENERATOR. THE MACHINE IS TO BE CAPABLE OF PRODUCING 2 KW OF ELECTRICAL POWER IN A 9 METER/SECOND (20 MILE/H) WIND, AND SHOULD REQUIRE NOT MORE THAN ONE MAN-DAY OF SERVICE PER YEAR. THE DESIGN CHARACTERISTICS AND OPERATING ECONOMICS ARE PRESENTED.
DESCRIPTORS	COST;ECONOMICS: Q1;POWER GENERATION;POWER RANGE 1-10 KW; SPECIFICATIONS: Q1;WIND TURBINES: T1

W-14

ACCESSION NO.	80C0055312
REPORT NO.PAGE	SERI/TP--31-248(VOL.2)(PT.2 PP. 599-612
TITLE	GRAPHITE-ALUMINUM COMPOSITE TECHNOLOGY
AUTHORS	MEYERER, W.; PAPRUCKI, S.
AUTHOR AFF	MATERIAL CONCEPTS, INC., COLUMBUS, OH
TITLE(MONO)	RELIABILITY OF MATERIALS FOR SOLAR ENERGY: WORKSHOP PROCEEDINGS
SEC REPT NO	CONF-781228--(VOL.2)(PT.2)
PAGE NO	599-612
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONF TITLE	RELIABILITY OF MATERIALS FOR SOLAR ENERGY WORKSHOP
CONF PLACE	DENVER, CO, USA
CONF DATE	16 DEC 1978
DATE	OCT 1979
CATEGORIES	EDB-170602;360303;360301
PRIMARY CAT	EDB-170602
REPORT NO	SERI/TP--31-248(VOL.2)(PT.2)
ABSTRACT	CONVENTIONAL AND ADVANCED FIBER-REINFORCED-NONMETAL MATRIX COMPOSITES ARE, AT PRESENT, HIGHLY COMPETITIVE WITH METAL-MATRIX COMPOSITES (MMCS) FROM THE STANDPOINTS OF DESIGN, CONFIDENCE, AND COST. THE SPECIFIC PROPERTIES OF TENSILE STRESS AND ELASTIC MODULUS OF CERTAIN FIBER-REINFORCED EPOXY COMPOSITES ARE EXTREMELY HIGH AND CAN BE EASILY UTILIZED IN APPLICATIONS IN WHICH AMBIENT TEMPERATURES PREVAIL AND IN ENVIRONMENTS OF LIMITED SEVERITY. METAL-MATRIX-COMPOSITE TECHNOLOGY IS PRESENTLY AT A POINT THAT IS COMPARABLE TO THE EARLY 1960S DEVELOPMENT OF NONMETALS COMPOSITES. IT IS IN ITS INFANCY, BUT IT IS RAPIDLY EMERGING FROM THAT STAGE AND DESERVES ATTENTION AS COMPLEMENTARY TECHNOLOGY. THE FACT OF ITS BEING COMPLEMENTARY IS OF GREAT IMPORTANCE. METAL-MATRIX-COMPOSITE TECHNOLOGY IS AN OFFSHOOT OF THE SAME DEVELOPMENT THAT PRODUCED GRAPHITE-EPOXY COMPOSITES AND IN THE FUTURE, MAY VERY WELL CARRY COMPOSITES INTO APPLICATIONS NOT FEASIBLE FOR PLASTICS.
DESCRIPTORS	ALUMINIUM;COMPOSITE MATERIALS: T3,Q2;FABRICATION: Q3;GRAPHITE; MECHANICAL PROPERTIES: Q3;TURBINE BLADES: T2,Q1;WIND TURBINES: T1

W-15

ACCESSION NO.	80C0049001
REPORT NO.PAGE	CONF-790845 PP. 75-76
TITLE	SITING MANUAL/SHORT COURSE FOR SMALL WIND ENERGY CONVERSION SYSTEMS
AUTHORS	HIESTER, T.R.
AUTHOR AFF	BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA
TITLE(MONO)	SOLAR 79 NORTHWEST
EDITOR OR COMP	KING, S. (ED.
PAGE NO	75-76
AVAILABILITY	DEP. NTIS, PC A19/MF A01.
CONF TITLE	SOLAR 79 NORTHWEST CONFERENCE
CONF PLACE	SEATTLE, WA, USA
CONF DATE	10 AUG 1979
DATE	1979
CATEGORIES	EDB-170604;290003
PRIMARY CAT	EDB-170604
REPORT NO	CONF-790845--
ABSTRACT	IMPROPER SITING THAT CAUSES LESS-THAN-EXPECTED ENERGY OUTPUT IS A COMMON CAUSE OF DISSATISFACTION AMONG SMALL WIND MACHINE USERS. TO ASSIST IN PROPER SITING, PACIFIC NORTHWEST LABORATORY (PNL), AS PART OF THE FEDERAL WIND ENERGY PROGRAM, PREPARES INFORMATION, SUCH AS A SITING HANDBOOK FOR SMALL WIND ENERGY CONVERSION SYSTEMS (WEGLEY ET AL., 1978). THIS HANDBOOK IS DESIGNED FOR THE LAYMAN INTERESTED IN WIND ENERGY CONVERSION. A SHORT COURSE IS BEING DEVELOPED TO PREPARE EXTENSION AGENTS, DEALERS' REPRESENTATIVES, ETC. TO HELP USERS SITE THEIR MACHINES. A SECOND SHORT COURSE IS ALSO BEING DEVELOPED TO PROVIDE WECS CONSUMERS WITH PERTINENT INFORMATION ON SITING WIND MACHINES.
DESCRIPTORS	OPTIMIZATION;SITE SELECTION: Q1;WIND TURBINES: T1

W-16

ACCESSION NO.	80R0048956
TITLE(MONO)	WIND ENERGY CONVERSION. VOLUME IV. DRIVE SYSTEM DYNAMICS
EDITOR OR COMP	MARTINEZ-SANCHEZ, M.; LABUSZEWSKI, T.
CORPORATE AUTH	MASSACHUSETTS INST. OF TECH., CAMBRIDGE (USA). AEROELASTIC AND STRUCTURES RESEARCH LAB.
PAGE NO	147
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EY-76-S-02-4131
DATE	SEP 1978
CATEGORIES	EDB-170603
PRIMARY CAT	EDB-170603
REPORT NO	COO--4131-11(VOL.4)
ABSTRACT	THE DYNAMICS OF THE DRIVE SYSTEM AND VARIOUS APPROACHES TO POWER TRANSMISSION ARE DESCRIBED. THE EFFECTS ON PERFORMANCE OF USING A CONSTANT ROTOR SPEED AS OPPOSED TO A ROTOR SPEED VARYING WITH THE WIND SPEED ARE DISCUSSED FOR VARIOUS ROTOR OPERATING SCHEDULES AND TYPICAL WIND DISTRIBUTIONS. THE DYNAMICS OF THE COMBINED ROTOR, ALTERNATOR, AND DRIVE SYSTEM ARE ANALYZED. CONDITIONS WHICH COULD LEAD TO ELECTRO-DYNAMIC INSTABILITIES AND DESYNCHRONIZATION ARE DISCUSSED AS WELL AS MEANS FOR STABILIZING THE SYSTEM. THE DYNAMICS OF THE DRIVE SYSTEM AND IMPORTANT DESIGN CONDITIONS FOR VARIOUS DRIVE SYSTEMS ARE DISCUSSED, SUCH AS LOCATION OF THE ALTERNATORS, USE OF HYDRAULIC DRIVE SYSTEMS AND SMOOTHING TECHNIQUES.
DESCRIPTORS	COMPARATIVE EVALUATIONS: Q2;ELECTRIC POWER;MECHANICAL TRANSMISSIONS: T2.01;OPERATION;PERFORMANCE: Q2;POWER GENERATION; WIND TURBINES: T1

W-17

ACCESSION NO.	80C0048974
REPORT NO.PAGE	CONF-790845--(SUPPL PP. 30-32
TITLE	FIELD EVALUATION PROGRAM FOR SMALL WIND ENERGY CONVERSION SYSTEMS
AUTHORS	ALDRED, J.
AUTHOR AFF	ENERGY SYSTEMS GROUP, GOLDEN, CO
TITLE(MONO)	SOLAR 79 NORTHWEST
EDITOR OR COMP	KING, S. (ED.
PAGE NO	30-32
AVAILABILITY	DEP. NTIS, PC A05/MF A01.
CONF TITLE	SOLAR 79 NORTHWEST CONFERENCE
CONF PLACE	SEATTLE, WA, USA
CONF DATE	10 AUG 1979
DATE	1979
CATEGORIES	EDB-170600;290003
PRIMARY CAT	EDB-170600
REPORT NO	CONF-790845--(SUPPL.)
ABSTRACT	THE DEPARTMENT OF ENERGY (DOE) HAS RECOGNIZED THE IMPORTANCE OF SMALL WIND SYSTEMS AND HAS INITIATED A NUMBER OF PROGRAMS DESIGNED TO ACCELERATE THE COMMERCIALIZATION OF THEM. THE PROGRAMS INCLUDE THE ESTABLISHMENT OF A WIND SYSTEMS TEST CENTER TO PROVIDE A CAPABILITY FOR INTENSIVE LONG-TERM TESTING OF SWECS, AND A TECHNICAL MANAGEMENT ORGANIZATION CHARTERED TO FOSTER THE DEVELOPMENT OF NEW, LOW COST MACHINES, PROVIDE SUPPORT TO THE DEVELOPMENT OF INDUSTRY STANDARDS, AND TO DISSEMINATE TECHNICAL INFORMATION TO INDUSTRY AND TO THE GENERAL PUBLIC. IN ADDITION, A FIELD EVALUATION PROGRAM HAS BEEN DESIGNED AS A PART OF THIS PROGRAM TO ACCELERATE THE COMMERCIALIZATION PROCESS FOR SWECS. THE PROGRAM GOAL IS TO PROVIDE NEAR-TERM RESOLUTION OF EXISTING TECHNICAL AND INSTITUTIONAL CONSTRAINTS IN ORDER THAT WIND ENERGY CAN EFFECT MAXIMUM IMPACT ON THE NATION'S ENERGY NEEDS.
DESCRIPTORS	PERFORMANCE TESTING: Q2;US DOE: T1;WIND TURBINES: T2.01

W-18

ACCESSION NO. 80C0044400
REPORT NO.PAGE SERI/TP--245-184 PP. 301-312
TITLE DEFINITIVE GENERIC STUDY FOR THE EFFECT OF HIGH LIFT AIRFOILS ON WIND TURBINE COST EFFECTIVENESS
AUTHORS LISSAMAN, P.B.S.; WILSON, R.E.; THRESHER, R.W.; WALKER, S.N.
AUTHOR AFF AEROVIRONMENT, INC., PASADENA, CA
TITLE(MONO) WIND ENERGY INNOVATIVE SYSTEMS CONFERENCE PROCEEDINGS
EDITOR OR COMP VAS, I.E. (ED.
SEC REPT NO CONF-790501--
PAGE NO 301-312
AVAILABILITY DEP. NTIS, PC A16/MF A01.
CONF TITLE WIND ENERGY INNOVATIVE SYSTEMS CONFERENCE
CONF PLACE COLORADO SPRINGS, CO, USA
CONF DATE 23 MAY 1979
DATE DEC 1979
CATEGORIES EDB-170602
PRIMARY CAT EDB-170602
REPORT NO SERI/TP--245-184
ABSTRACT THE EFFECT OF HIGH LIFT DEVICES ON THE SYSTEM COST-EFFECTIVENESS OF WIND TURBINES WAS STUDIED FOR THE CASE OF BOTH HORIZONTAL AXIS AND VERTICAL AXIS MACHINES. A COMPREHENSIVE REVIEW OF THE VARIOUS TYPES OF HIGH LIFT AIRFOIL SECTIONS WAS PERFORMED WITH RESPECT TO GENERALIZED AERODYNAMIC PERFORMANCE AND STRUCTURAL CONSIDERATIONS. AIRFOILS HAVING PROMISE INCLUDED HIGH LIFT INCIPIENT SEPARATION SECTIONS, SYMMETRICAL HIGH LIFT AIR FOILS, AND EXTRA THICK DESIGNS. JET FLAPS AND MULTI-ELEMENT SECTIONS WERE DETERMINED TO BE TOO COMPLICATED FOR PRACTICAL APPLICATIONS. THE PERFORMANCES OF BOTH HORIZONTAL AXIS (NASA MOD-X) AND VERTICAL AXIS (SANDIA LAB DARRIEUS) WIND TURBINES WERE MODELED FOR BASELINE CASES, ASSUMING UNITS RATED AT 200 KW, FOR A VARIETY OF DIFFERENT ROTOR AIRFOIL SECTIONS AND PLANFORMS.
DESCRIPTORS AERODYNAMICS;AIRFOILS: T3,01,02;COMPARATIVE EVALUATIONS;COST: Q3;EFFICIENCY;PERFORMANCE TESTING: Q3;TURBINE BLADES;VERTICAL AXIS TURBINES: T2;WIND TURBINES: T1

W-19

ACCESSION NO. 80R0033960
TITLE(MONO) DESIGN STUDY AND ECONOMIC ASSESSMENT OF MULTI-UNIT OFFSHORE WIND ENERGY CONVERSION SYSTEMS APPLICATION. VOLUME II. APPARATUS DESIGNS AND COSTS. FINAL REPORT
EDITOR OR COMP KILAR, L.A.
CORPORATE AUTH WESTINGHOUSE ELECTRIC CORP., EAST PITTSBURGH, PA (USA)
PAGE NO 310
AVAILABILITY DEP. NTIS, PC A14/MF A01.
CONTRACT NO CONTRACT EX-76-C-01-2330
DATE 14 JUN 1979
CATEGORIES EDB-170602
PRIMARY CAT EDB-170602
REPORT NO WASH--2330-76/4(VOL.2)
ABSTRACT PARAMETRIC DESIGNS AND COMPANION COST FUNCTIONS ARE PRESENTED FOR EACH MAJOR COMPONENT OF AN OFFSHORE WIND ENERGY CONVERSION SYSTEM (OWECS). THESE ARE (1) THE SUPPORT PLATFORMS, (2) THE WIND TURBINE GENERATOR (WTG) PLANTS, AND (3) THE ELECTRICAL ENERGY COLLECTION AND TRANSMISSION SYSTEM INCLUDING (4) SUBSTATIONS. A BACKUP HYDROGEN ENERGY DELIVERY SYSTEM FOR EXTREMELY REMOTE OR DEEP WATER SITES WAS ALSO EVALUATED. COSTS ARE PRESENTED FOR FABRICATING, TRANSPORTING, INSTALLING, OPERATING, AND MAINTAINING EACH OF THESE COMPONENTS.
DESCRIPTORS COST;DESIGN: Q2,Q3;FEASIBILITY STUDIES: Q1;OFFSHORE PLATFORMS: T2;OFFSHORE SITES: Q1;POWER GENERATION;POWER TRANSMISSION;WIND POWER PLANTS: T1;WIND TURBINES: T3

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W-20

ACCESSION NO. 80C0033975
REPORT NO.PAGE NASA-CP--2106 PP. 267-284
TITLE DESIGN, FABRICATION, AND TEST OF A STEEL SPAR WIND TURBINE BLADE
AUTHORS SULLIVAN, T.L.; SIROCKY, JR.; VITERNA, L.A.
AUTHOR AFF LEWIS RESEARCH CENTER, CLEVELAND, OH
TITLE(MONO) LARGE WIND TURBINE DESIGN CHARACTERISTICS AND R AND D REQUIREMENTS
EDITOR OR COMP LIEBLEIN, S. (ED.
SEC REPT NO CONF-7904111—
PAGE NO 267-284
AVAILABILITY DEP. NTIS, PC A20/MF A01.
CONF TITLE CONFERENCE ON LARGE WIND TURBINE CHARACTERISTICS AND R AND D REQUIREMENTS
CONF PLACE CLEVELAND, OH, USA
CONF DATE 24 APR 1979
DATE 1979
CATEGORIES EDB-170602
PRIMARY CAT EDB-170602
REPORT NO NASA-CP--2106
ABSTRACT ONE POTENTIAL MEANS FOR REDUCING THE COSTS OF WIND TURBINE BLADES IS TO USE A MASS PRODUCED STRUCTURE AS THE PRIMARY STRUCTURAL MEMBER OF THE BLADE. TAPERED BEAMS SUCH AS THOSE USED FOR UTILITY POLES ARE THE TYPE OF MASS PRODUCED STRUCTURE ENVISAGED. THE AIRFOIL SHAPE COULD BE FORMED BY LIGHT-WEIGHT FOAM OR LIGHT-WEIGHT RIBS OVERWRAPPED WITH FIBERGLASS CLOTH. IN ORDER TO DETERMINE THE FEASIBILITY OF THIS CONCEPT, A 60 FT. STEEL SPAR BLADE WAS DESIGNED. USING THIS DESIGN, TWO BLADES WERE FABRICATED AT THE LEWIS RESEARCH CENTER AND TESTED ON THE MOD-0 WIND TURBINE. THE DESIGN AND FABRICATION OF THE BLADES ARE DESCRIBED. PERFORMANCE AND BLADE LOAD INFORMATION IS GIVEN AND COMPARED TO ANALYTICAL PREDICTION. IN ADDITION, PERFORMANCE IS COMPARED TO THAT OF THE ORIGINAL MOD-0 ALUMINUM BLADES. COSTS FOR BUILDING THE TWO BLADES IS GIVEN, AND A PROJECTION IS MADE FOR THE COST IN MASS PRODUCTION. FINALLY, DESIGN IMPROVEMENTS TO REDUCE WEIGHT AND IMPROVE FATIGUE LIFE ARE SUGGESTED.
DESCRIPTORS COST: Q1;DESIGN;FABRICATION: Q2;STRESS ANALYSIS;TURBINE BLADES: T2,Q1;WIND TURBINES: T1

W-21

ACCESSION NO.	80R0033956
TITLE(MONO)	EVALUATION OF FEASIBILITY OF PRESTRESSED CONCRETE FOR USE IN WIND TURBINE BLADES
EDITOR OR COMP	LIEBLEIN, S.; LUNDAHL, D.S.; FURLONG, D.B.; PEERY, D.J.; DREIER, M.L.
CORPORATE AUTH	TECHNICAL REPORT SERVICES, ROCKY RIVER, OH (USA); TUTHILL PUMP CO. OF CALIFORNIA, SAN RAFAEL (USA); PARAGON PACIFIC, INC., EL SEGUNDO, CA (USA)
SEC REPT NO	NASA-CR--159725
PAGE NO	120
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1028
DATE	SEP 1979
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	DOE/NASA/5906--79/1
ABSTRACT	AS A PART OF THE DOE/NASA RESEARCH PROGRAM ON WIND ENERGY, A PRELIMINARY EVALUATION WAS CONDUCTED OF THE FEASIBILITY OF THE USE OF PRESTRESSED CONCRETE AS A MATERIAL FOR LOW-COST BLADES FOR WIND TURBINES. A BASELINE BLADE DESIGN WAS ACHIEVED FOR THE DOE/NASA MOD-0 100 KW EXPERIMENTAL WIND TURBINE THAT MET AERODYNAMIC AND STRUCTURAL REQUIREMENTS. CALCULATED BLADE WEIGHT AND COST WERE 4900 LB AND AROUND $18,000, COMPARED TO 2000 LB AND AROUND $200,000 FOR A MOD-0 ALUMINUM BLADE. SIGNIFICANT COST REDUCTIONS WERE INDICATED FOR VOLUME PRODUCTION. CASTING OF A MODEL BLADE SECTION SHOWED NO FABRICATION PROBLEMS. COUPLED DYNAMIC ANALYSIS REVEALED THAT ADVERSE ROTOR-TOWER INTERACTIONS CAN BE SIGNIFICANT WITH HEAVY ROTOR BLADES. DESIGN OPTIONS ARE DISCUSSED. AREAS OF FURTHER INVESTIGATION ARE IDENTIFIED TO VERIFY THE DESIGN APPROACH AND TO PROVIDE THE PROPERTY DATA BASE REQUIRED FOR CONCRETE BLADE DESIGN.
DESCRIPTORS	COST;DESIGN;FABRICATION;FEASIBILITY STUDIES: Q2;PRESTRESSED CONCRETE;STRESS ANALYSIS;TURBINE BLADES: T2,Q1;WIND TURBINES T1

W-22

ACCESSION NO.	80C0033929
REPORT NO,PAGE	NASA-CP--2106 PP. 1-23
TITLE	OVERVIEW OF FEDERAL WIND ENERGY PROGRAM
AUTHORS	ANCONA, D.F.
AUTHOR AFF	DEPT. OF ENERGY, WASHINGTON, DC
TITLE(MONO)	LARGE WIND TURBINE DESIGN CHARACTERISTICS AND R AND D REQUIREMENTS
EDITOR OR COMP	LIEBLEIN, S. (ED.
SEC REPT NO	CONF-7904111—
PAGE NO	1-23
AVAILABILITY	DEP. NTIS, PC A20/MF A01.
CONF TITLE	CONFERENCE ON LARGE WIND TURBINE CHARACTERISTICS AND R AND D REQUIREMENTS
CONF PLACE	CLEVELAND, OH, USA
CONF DATE	24 APR 1979
DATE	1979
CATEGORIES	EDB-170100;170602
PRIMARY CAT	EDB-170100
REPORT NO	NASA-CP--2106
ABSTRACT	A BRIEF OVERVIEW IS PRESENTED OF WHAT THE FEDERAL WIND PROGRAM IS TODAY, WHAT THE OBJECTIVES ARE, AND WHAT STRATEGIES ARE BEING FOLLOWED. SOME OF THE CHANGES IN THE PROGRAM STRUCTURE AND SOME OF THE ADDITIONS TO THE PROGRAM ARE ALSO INCLUDED. MENTION IS MADE OF UPCOMING ORGANIZATIONAL CHANGES, AND SOME BUDGET ITEMS ARE COVERED, WITH PARTICULAR MENTION OF SOME RECENT SIGNIFICANT EVENTS REGARDING NEW APPROVALS.
DESCRIPTORS	AVAILABILITY: Q2;PLANNING: Q4;RESEARCH PROGRAMS: Q3;RESOURCE ASSESSMENT;USA: T1;WIND POWER: T2,Q1;WIND POWER PLANTS: T4,Q1; WIND TURBINES: T3,Q1

W-23

ACCESSION NO.	80R0027675
TITLE(MONO)	VERTICAL AXIS WIND TURBINE DEVELOPMENT. EXECUTIVE SUMMARY. FINAL REPORT, MARCH 1, 1976-JUNE 30, 1977
EDITOR OR COMP	WALTERS, R.E.; FANUCCI, J.B.; HILL, P.W.; MIGLIORE, P.G.
CORPORATE AUTH	WEST VIRGINIA UNIV., MORGANTOWN (USA). DEPT. OF AEROSPACE ENGINEERING
PAGE NO	26

AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT EY-76-C-05-5135
DATE JUL 1979
CATEGORIES EDB-170602
PRIMARY CAT EDB-170602
REPORT NO ORO--5135-77/5(SUMM.)
ABSTRACT INFORMATION IS PRESENTED CONCERNING THE NUMERICAL SOLUTION OF THE AERODYNAMICS OF CROSS-FLOW WIND TURBINES; BOUNDARY LAYER CONSIDERATIONS FOR A VERTICAL AXIS WIND TURBINE; WVU VAWT OUTDOOR TEST MODEL; LOW SOLIDITY BLADE TESTS; HIGH SOLIDITY BLADE DESIGN; COST ANALYSIS OF THE WVU VAWT TEST MODEL; STRUCTURAL PARAMETRIC ANALYSIS OF VAWT BLADES; AND COST STUDY OF CURRENT WECS.
DESCRIPTORS AERODYNAMICS: Q1;COST;GIROMILL TURBINES: T1;PERFORMANCE TESTING: Q1;POWER COEFFICIENT;TURBINE BLADES

W-24

ACCESSION NO. 80C0026529
REPORT NO,PAGE CONF-790352 PP. 3-43
TITLE OVERVIEW: DEPARTMENT OF ENERGY WIND ENERGY PROGRAM
AUTHORS ANCONA, D.F.
AUTHOR AFF DEPT. OF ENERGY, WASHINGTON, DC
TITLE(MONO) PROCEEDINGS OF THE WORKSHOP ON ECONOMIC AND OPERATIONAL REQUIREMENTS AND STATUS OF LARGE SCALE WIND SYSTEMS
EDITOR OR COMP CLARK, E.F.; DE WINTER, F. (EDS.
PAGE NO 3-43
AVAILABILITY DEP. NTIS, PC A20/MF A01.
CONF TITLE WORKSHOP ON ECONOMIC AND OPERATIONAL REQUIREMENTS AND STATUS OF LARGE SCALE WIND SYSTEMS
CONF PLACE MONTEREY, CA, USA
CONF DATE 26 MAR 1979
DATE JUN 1979
CATEGORIES EDB-170602;299003
PRIMARY CAT EDB-170602
REPORT NO CONF-790352--
ABSTRACT THE DEPARTMENT OF ENERGY FEDERAL WIND PROGRAM IS DESCRIBED FOR BOTH LARGE TURBINES AND SMALL INNOVATIVE CONCEPTS. BUDGET INFORMATION IS ALSO INCLUDED.
DESCRIPTORS BUDGETS;PERFORMANCE TESTING;PLANNING: Q2,Q3;RESEARCH PROGRAMS: US DOE: T1;WIND POWER PLANTS: T3,Q1;WIND TURBINES: T2,Q1

W-25

ACCESSION NO. 80R0020513
TITLE(MONO) WIND POWER. VOLUME 2. 1978-APRIL 1979 (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1978-APRIL 1979
EDITOR OR COMP HUNDEMANN, A.S.
CORPORATE AUTH NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA (USA)
PAGE NO 131
AVAILABILITY NTIS PC N01/MF N01.
DATE JUN 1979
CATEGORIES EDB-170000
PRIMARY CAT EDB-170000
REPORT NO NTIS/PS--79/0536
ABSTRACT WINDMILL AND WIND POWER FEASIBILITY, USE, AND ENGINEERING ARE DISCUSSED IN THESE CITATIONS OF WORLDWIDE RESEARCH. ABSTRACTS PRIMARILY COVER THE USE OF WIND POWER FOR ELECTRIC POWER GENERATION AND WIND TURBINE DESIGN AND PERFORMANCE. GENERAL STUDIES DEALING WITH THE USE OF WIND POWER IN DEVELOPING COUNTRIES AND COMPARATIVE ANALYSES OF WIND POWER AND ALTERNATIVE ENERGY SOURCES ARE INCLUDED, AS ARE STUDIES ON ENERGY STORAGE SYSTEMS. (THIS UPDATED BIBLIOGRAPHY CONTAINS 125 ABSTRACTS, 113 OF WHICH ARE NEW ENTRIES TO THE PREVIOUS EDITION.)
DESCRIPTORS BIBLIOGRAPHIES: Q1;COST;DESIGN;EFFICIENCY;WIND POWER: T1;WIND TURBINES

W-26

ACCESSION NO. 80R0020512
TITLE(MONO) WIND POWER. VOLUME 1. 1970-1977 (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1970-1977
EDITOR OR COMP HUNDEMANN, A.S.
CORPORATE AUTH NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA (USA)
PAGE NO 225
AVAILABILITY NTIS PC N01/MF N01.
DATE JUN 1979
CATEGORIES EDB-170000
PRIMARY CAT EDB-170000
REPORT NO NTIS/PS--79/0535
ABSTRACT WINDMILL AND WIND POWER FEASIBILITY, USE, AND ENGINEERING ARE DISCUSSED IN THESE CITATIONS OF WORLDWIDE RESEARCH. ABSTRACTS PRIMARILY COVER THE USE OF WIND POWER FOR ELECTRIC POWER GENERATION AND WIND TURBINE DESIGN AND PERFORMANCE. GENERAL STUDIES DEALING WITH THE USE OF WIND POWER IN DEVELOPING COUNTRIES AND COMPARATIVE ANALYSES OF WIND POWER AND ALTERNATIVE ENERGY SOURCES ARE INCLUDED, AS ARE STUDIES ON ENERGY STORAGE SYSTEMS. (THIS UPDATED BIBLIOGRAPHY CONTAINS 219 ABSTRACTS, NONE OF WHICH ARE NEW ENTRIES TO THE PREVIOUS EDITION.)
DESCRIPTORS BIBLIOGRAPHIES: Q1;COST;DESIGN;EFFICIENCY;WIND POWER: T1;WIND TURBINES

W-27

ACCESSION NO. 80R0020511
TITLE(MONO) WIND POWER. VOLUME 2. 1977-APRIL 1979 (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1977-APRIL 1979
EDITOR OR COMP HUNDEMANN, A.S.
CORPORATE AUTH NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA (USA)
PAGE NO 282
AVAILABILITY NTIS PC N01/MF N01.
DATE JUN 1979
CATEGORIES EDB-170000
PRIMARY CAT EDB-170000
REPORT NO NTIS/PS--79/0534
ABSTRACT THE FEASIBILITY, USE, AND ENGINEERING ASPECTS OF WIND POWER AND WINDMILLS ARE DISCUSSED IN THESE CITATIONS OF FEDERALLY-FUNDED RESEARCH REPORTS. ABSTRACTS PRIMARILY COVER THE USE OF WIND POWER FOR ELECTRIC POWER GENERATION AND WIND TURBINE DESIGN AND PERFORMANCE. GENERAL STUDIES DEALING WITH COMPARATIVE ANALYSES OF WIND POWER AND ALTERNATIVE ENERGY SOURCES ARE INCLUDED, AS ARE ENERGY STORAGE DEVICES WHICH CAN BE USED IN THESE SYSTEMS. (THIS UPDATED BIBLIOGRAPHY CONTAINS 276 ABSTRACTS, 123 OF WHICH ARE NEW ENTRIES TO THE PREVIOUS EDITION.)
DESCRIPTORS BIBLIOGRAPHIES: Q1;COST;DESIGN;EFFICIENCY;WIND POWER: T1;WIND TURBINES

W-28

ACCESSION NO.	79R0130224
TITLE(MONO)	ESTIMATION OF WIND CHARACTERISTICS AT POTENTIAL WIND ENERGY CONVERSION SITES
CORPORATE AUTH	SRI INTERNATIONAL, MENLO PARK, CA (USA)
PAGE NO	149
AVAILABILITY	DEP. NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT EY-76-C-06-1830
DATE	OCT 1979
CATEGORIES	EDB-170004
PRIMARY CAT	EDB-170004
REPORT NO	PNL--3074
ABSTRACT	A PRACTICAL METHOD HAS BEEN DEVELOPED AND APPLIED TO THE PROBLEM OF DETERMINING WIND CHARACTERISTICS AT CANDIDATE WIND ENERGY CONVERSION SITES WHERE THERE ARE NO AVAILABLE HISTORICAL DATA. THE METHOD USES A MASS CONSISTENT WIND FLOW MODEL (CALLED COMPLEX) TO INTERPOLATE BETWEEN STATIONS WHERE WIND DATA ARE AVAILABLE. THE COMPLEX MODEL INCORPORATES THE EFFECTS OF TERRAIN FEATURES AND AIRFLOW. THE KEY TO THE PRACTICAL APPLICATION OF COMPLEX TO THE DERIVATION OF WIND STATISTICS IS THE MODEL'S LINEARITY. THIS ALLOWS THE INPUT DATA SETS TO BE RESOLVED INTO ORTHOGONAL COMPONENTS ALONG THE SET OF EIGENVECTORS OF THE COVARIANCE MATRIX. THE SOLUTION FOR EACH EIGENVECTOR IS DETERMINED WITH COMPLEX; THE HOURLY INTERPOLATED WINDS ARE THEN FORMED FROM LINEAR COMBINATIONS OF THESE SOLUTIONS. THE PROCEDURE REQUIRES: ACQUISITION AND MERGER OF WIND DATA FROM THREE TO FIVE STATIONS, APPLICATION OF COMPLEX TO EACH OF THE SEVEN TO 11 (DEPENDING ON THE NUMBER OF STATIONS FOR WHICH WIND DATA ARE AVAILABLE) EIGENVECTORS, RECONSTRUCTION OF THE HOURLY INTERPOLATED WINDS AT THE SITE FROM THE EIGENVECTOR SOLUTIONS, AND FINALLY, ESTIMATING THE WIND CHARACTERISTICS FROM THE SIMULATED HOURLY VALUES. THE REPORT DESCRIBES THE METHODOLOGY AND THE UNDERLYING THEORY. POSSIBLE IMPROVEMENTS TO THE PROCEDURE ARE ALSO DISCUSSED.
DESCRIPTORS	AVAILABILITY: Q1;METEOROLOGY;MONITORING;SITE SELECTION: Q2; STATISTICAL MODELS;WIND POWER: T1;WIND TURBINES: T2

W-29

99/5/0000064-00000327/ 30

ACCESSION NO.	79R0130222
TITLE(MONO)	GENERAL RELIABILITY AND SAFETY METHODOLOGY AND ITS APPLICATION TO WIND ENERGY CONVERSION SYSTEMS
EDITOR OR COMP	EDESESS, M.; MCCONNELL, R.D.
CORPORATE AUTH	SOLAR ENERGY RESEARCH INST., GOLDEN, CO (USA)
PAGE NO	52
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EG-77-C-01-4042
DATE	SEP 1979
CATEGORIES	EDB-170002
PRIMARY CAT	EDB-170002
REPORT NO	SERI/TR--35-234
ABSTRACT	IN CONVENTIONAL SYSTEM RELIABILITY CALCULATIONS, EACH COMPONENT MAY BE IN THE OPERABLE STATE OR THE UNDER REPAIR STATE. THESE CALCULATIONS DERIVE SYSTEM UNAVAILABILITY, OR THE PROBABILITY OF THE SYSTEM'S BEING DOWN FOR REPAIRS. BY INTRODUCING A THIRD COMPONENT STATE BETWEEN OPERABLE AND UNDER REPAIR - NAMELY, DEFECTIVE, BUT DEFECT UNDETECTED - THE METHODS DEVELOPED IN THIS REPORT ENABLE SYSTEM SAFETY PROJECTIONS TO BE MADE IN ADDITION TO AVAILABILITY PROJECTIONS. ALSO PROVIDED IS A MECHANISM FOR COMPUTING THE EFFECT OF INSPECTION SCHEDULES ON BOTH SAFETY AND AVAILABILITY. A RELIABILITY AND SAFETY PROGRAM (RASP) IS DETAILED WHICH PERFORMS THESE COMPUTATIONS AND ALSO CALCULATES COSTS FOR SYSTEM INSPECTIONS AND REPAIRS. RASP IS APPLIED TO A SIMPLIFIED WIND ENERGY CONVERSION SYSTEM EXAMPLE.
DESCRIPTORS	COMPUTER CALCULATIONS;PERFORMANCE;PROBABILITY;QUALITY ASSURANCE; RELIABILITY: Q1;WIND TURBINES: T1

W-30

ACCESSION NO.	79C0129840
TITLE	MECHANICAL AND CONTROL SYSTEM DESIGN OF THE US DEPARTMENT OF ENERGY EXPERIMENTAL MOD-0 100 KW WIND TURBINE
AUTHORS	GLASGOW, J.C.; BIRCHENOUGH, A.G.
AUTHOR AFF	NASA, LEWIS RES CENT, CLEVELAND, OHIO
TITLE(MONO)	CLEVELAND ELECTRICAL/ELECTRONICS CONFERENCE
PAGE NO	106-111
PUBL LOC	INST. OF ELECTRICAL AND ELECTRONICS ENGINEERS, NEW YORK, NY
DATE	1978
CATEGORIES	EDB-170602;990200
PRIMARY CAT	EDB-170602
ABSTRACT	THE MOD-0 100 KW EXPERIMENTAL WIND TURBINE WAS DESIGNED AND FABRICATED BY NASA, AS PART OF THE FEDERAL WIND ENERGY PROGRAM, TO ASSESS TECHNOLOGY REQUIREMENTS AND ENGINEERING PROBLEMS OF LARGE WIND TURBINES. THE MACHINE BECAME OPERATIONAL IN OCTOBER 1975 AND HAS DEMONSTRATED SUCCESSFUL OPERATION IN ALL OF ITS DESIGN MODES. DURING THE COURSE OF ITS OPERATIONS THE MACHINE HAS GENERATED EXPERIMENTAL DATA AND HAS SERVED AS A PROTOTYPE DEVELOPMENTAL TEST BED FOR THE MOD-0A OPERATIONAL WIND TURBINES WHICH ARE CURRENTLY USED ON UTILITY NETWORKS. THIS PAPER DESCRIBES THE MECHANICAL AND CONTROL SYSTEMS AS THEY EVOLVED IN OPERATIONAL TESTS AND SOME OF THE TEST RESULTS WITH THE POWER CONTROLLER.
DESCRIPTORS	CONTROL SYSTEMS: Q1;MICROPROCESSORS: T1;NASA;OHIO;OPERATION; POWER RANGE 10-100 KW: Q1;SAFETY;US DOE;WIND POWER;WIND TURBINES: T1

W-31

ACCESSION NO.	79J0122812
TITLE	WIND BLOWS ANEW
AUTHORS	KILAR, L.A.
AUTHOR AFF	WESTINGHOUSE ELECTR CORP
PUB DESC	POWER (N.Y.), V. 123, NO. 5, PP. 40-42
DATE	MAY 1979
CATEGORIES	EDB-170600
PRIMARY CAT	EDB-170600
ABSTRACT	BUSBAR ENERGY COSTS OF WIND-ENERGY CONVERSION SYSTEMS (WECS) DEPEND ON ENVIRONMENTAL AND APPLICATION PARAMETERS AS WELL AS ON MACHINE TYPE, BUT 40 TO 80 MILLS/KWH IS TYPICAL OF CURRENT FORECASTS FOR INTERMEDIATE (100-600-KW) AND LARGE (OVER-600-KW)

W-32

ACCESSION NO.	79R0116609
TITLE(MONO)	SOLAR/WIND HANDBOOK FOR HAWAII: TECHNICAL APPLICATIONS FOR HAWAII, THE PACIFIC BASIN AND SITES WORLDWIDE WITH SIMILAR CLIMATIC CONDITIONS
EDITOR OR COMP	FALICOFF, W.; KOIDE, G.; TAKAHASHI, P.
CORPORATE AUTH	HAWAII UNIV., MANOA (USA). HAWAII NATURAL ENERGY INST.; HAWAII UNIV.--HILO COLL. (USA); HAWAII STATE DEPT. OF PLANNING AND ECONOMIC DEVELOPMENT, HONOLULU (USA)
PAGE NO	647
AVAILABILITY	DEP. NTIS, PC A99/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-48
DATE	MAY 1979
CATEGORIES	EDB-140000;170000
PRIMARY CAT	EDB-140000
AUGMENTATION	CONTAINS GLOSSARY
REPORT NO	UCRL--15053
ABSTRACT	THE TECHNIQUES ARE PRESENTED FOR USING SOLAR ENERGY AND WIND POWER IN APPLICATIONS SUCH AS DOMESTIC HOT WATER PRODUCTION, SPACE COOLING, PROCESS HEATING, AND POWER GENERATION. THE FINDINGS AND INFORMATION ARE BASED UPON CONDITIONS IN HAWAII, BUT CAN APPLY TO LOCATIONS WITH SIMILAR ENVIRONMENTS SUCH AS THE ENTIRE PACIFIC AREA. (MHR)
DESCRIPTORS	CLOUD COVER;CROPS;ENERGY STORAGE;FEASIBILITY STUDIES: Q3;FLAT PLATE COLLECTORS;INSOLATION;LIFE-CYCLE COST;MANUALS: Q1,Q2; REVIEWS: Q1,Q2;SOLAR DRYING;SOLAR ENERGY: M1;SOLAR PROCESS HEAT; SOLAR SPACE HEATING;USES;WIND POWER: M2;WIND TURBINES: T3

W-33

ACCESSION NO.	79B0110474
TITLE(MONO)	WIND ENERGY IN THEORY AND PRACTICE. BASIC AND APPLICATIONS
TITLE(ORIG)	WINDENERGIE IN THEORIE UND PRAXIS. GRUNDLAGEN UND EINSATZ
EDITOR OR COMP	MOLLY, J.P.
ED AFF	DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT E.V., STUTTGART (GERMANY, F.R.). INST. FUER BAUWEISEN- UND KONSTRUKTIONSFORSCHUNG
PAGE NO	136
PUBL LOC	C.F. MUELLER, KARLSRUHE, GERMANY, F.R.
DATE	1978
LANGUAGE	IN GERMAN
CATEGORIES	EDB-170600
PRIMARY CAT	EDB-170600
AUGMENTATION	BOOK; IN GERMAN
ABSTRACT	THE FIRST CHAPTER OF THE BOOK DEALS WITH THE THEORY OF WIND TURBINES. AFTER AN OUTLINE OF THE DISTRIBUTION OF WIND CURRENTS ON THE EARTH AND CHARACTERISTIC FEATURES OF WIND CURRENTS, THE THIRD CHAPTER THEN DISCUSSES THE DESIGN OF WIND ENERGY CONVERTERS. THE 4TH AND 5TH CHAPTERS GIVE A SURVEY OF PROJECTS REALIZED AND OF THE RESULTS OF RESEARCH PROGRAMS IN THIS FIELD. FINALLY, THE AUTHOR DEALS WITH THE PROBLEM OF INVESTMENT AND OPERATING COSTS OF WIND POWER PLANTS.
DESCRIPTORS	AERODYNAMICS;CONTROL EQUIPMENT;COST;DESIGN: Q3;ECONOMICS: Q2; ELECTRIC GENERATORS;ENERGY STORAGE;ENERGY YIELD;OPERATION; ROTORS;TECHNOLOGY UTILIZATION: Q1;TURBINE BLADES;WIND;WIND POWER: M1;WIND POWER PLANTS: M2;WIND TURBINES: M3

W-34

ACCESSION NO.	79C0104166
TITLE(MONO)	USE OF WIND DATA WITH AN OPERATIONAL WIND TURBINE IN A RESEARCH AND DEVELOPMENT ENVIRONMENT
EDITOR OR COMP	NEUSTADTER, H.E.
CORPORATE AUTH	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO	NASA-TM--79832; CONF-790665--1
PAGE NO	14
AVAILABILITY	P 02/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1004
CONF TITLE	AMERICAN METEROLOGICAL SOCIETY
CONF PLACE	PORTLAND, OR, USA
CONF DATE	19 JUN 1979
DATE	1979
CATEGORIES	EDB-170602;170604
PRIMARY CAT	EDB-170602
AUGMENTATION	NEW MEXICO
REPORT NO	DOE/NASA/1004--79/16
ABSTRACT	THE NEED TO MEASURE AND COLLECT WIND DATA PERSISTS WELL AFTER A WIND TURBINE IS INITIALLY MADE OPERATIONAL. THIS IS PARTICULARLY THE CASE IN AN R AND D PROGRAM SUCH AS THE WIND ENERGY PROJECT BEING CONDUCTED BY LEWIS RESEARCH CENTER FOR THE DEPARTMENT OF ENERGY. THE STATUS IS PRESENTED OF THE USE OF WIND INFORMATION IN FOUR AREAS, NAMELY: OPERATIONAL CONTROL, DESIGN VERIFICATION, POWER PERFORMANCE ANALYSIS, AND LIFETIME ESTIMATION. ATTENTION IS ALSO GIVEN TO SOME OF THE IDENTIFIED, BUT AS YET UNMET, WIND INFORMATIONAL NEEDS AND THE STEPS PLANNED TO MEET THESE NEEDS.
DESCRIPTORS	DATA ACQUISITION;MONITORING: Q2;NASA;NEW MEXICO: T3;POWER RANGE 100-1000 KW;SITE SELECTION;SPECIFICATIONS: Q1;WIND POWER: M2; WIND TURBINES: M1,Q3

W-35

ACCESSION NO.	79C0077601
TITLE	NORTH WIND'S KW HIGH RELIABILITY WTG PROGRAM
AUTHORS	MAYER, D.
TITLE(MONO)	PROCEEDINGS OF THE NATIONAL CONFERENCE: AMERICAN WIND ENERGY ASSOCIATION
EDITOR OR COMP	NELSON, V. (ED.)
SEC REPT NO	CONF-780357--
PAGE NO	50-52
CONF TITLE	NATIONAL CONFERENCE OF THE AMERICAN WIND ENERGY ASSOCIATION
CONF PLACE	AMARILLO, TX, USA
CONF DATE	1 MAR 1976
PUBL LOC	WEST TEXAS STATE UNIV., CANYON, TX
DATE	1976
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
ABSTRACT	SPECIFICATIONS ARE PRESENTED FOR A 1-2 KW HIGH RELIABILITY HORIZONTAL-AXIS PROPELLER-TYPE WIND TURBINE.
DESCRIPTORS	CONTROL SYSTEMS;POWER RANGE 1-10 KW;SPECIFICATIONS: Q1;WIND TURBINES: T1

W-36

ACCESSION NO.	79J0062017
TITLE	WINDMILL'S THEORETICAL MAXIMUM EXTRACTION OF POWER FROM THE WIND
AUTHORS	INGLIS, D.R.
AUTHOR AFF	DEPARTMENT OF PHYSICS AND ASTRONOMY, UNIVERSITY OF MASSACHUSETTS, AMHERST, MASSACHUSETTS 01002
PUB DESC	AM. J. PHYS., V. 47, NO. 5, PP. 416-420
DATE	MAY 1979
CATEGORIES	EDB-170000
PRIMARY CAT	EDB-170000
ABSTRACT	THE FRACTION OF THE KINETIC ENERGY OF THE WIND IMPINGING ON ITS AREA, THAT A WIND TURBINE CAN CONVERT TO USEFUL POWER, HAS BEEN SHOWN BY BETZ IN AN IDEALIZED LAMINAR-FLOW MODEL TO HAVE AN UPPER LIMIT OF 16/27 OR 59%. THE LIMIT IS HERE SIMPLY REDERIVED AND IT IS SHOWN HOW DEVIATIONS FROM THE IDEALIZED MODEL, INVOLVING ROTATIONAL KINETIC ENERGY OF THE DOWNWIND STREAM AND TURBULENT MIXING FROM OUTSIDE THE BOUNDARIES OF THE IDEALIZED STREAM, CAN EITHER INCREASE OR DECREASE THE POWER AVAILABLE. THE LIMIT IS THUS NOT A STRICT UPPER LIMIT IN PRACTICE.
DESCRIPTORS	AERODYNAMICS;ELECTRIC GENERATORS;ENERGY EFFICIENCY: Q1; HYDRODYNAMICS;WIND;WIND POWER: T1;WIND TURBINES

W-37

ACCESSION NO.	79J0061558
TITLE	STUDIES OF THE AERODYNAMIC PERFORMANCE OF A 10 KW HORIZONTAL-AXIS WINDMILL
AUTHORS	FIGARD, R.L.; SCHETZ, J.A.
AUTHOR AFF	VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG
PUB DESC	J. ENERGY, V. 3, NO. 1, PP. 3-7
DATE	JAN 1979
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
ABSTRACT	THE AERODYNAMIC PERFORMANCE OF A MODERN, HIGH-TIP-SPEED, THREE-BLADED WINDMILL RATED AT 10KW AT 30 MPH WAS STUDIED BY THREE METHODS. FIRST, THE RESULTS OF FIELD TESTS OF THE ACTUAL DEVICE WITH BOTH A RESISTIVE AND A BATTERY-CHARGING ELECTRIC LOAD ARE REPORTED. SECOND, THE PREDICTIONS OF A SIMPLE BLADE-ELEMENT ANALYSIS ARE PRESENTED AND COMPARED WITH THE FIELD DATA. AERODYNAMIC BLADE SECTION COEFFICIENTS OF AN ACTUAL BLADE SECTION WERE MEASURED IN A WIND TUNNEL AND USED AS INPUT IN THE ANALYSIS. THIRD, WIND TUNNEL TEST RESULTS FOR A 1/5 TH SCALE MODEL ARE GIVEN. REYNOLDS NUMBER SIMULATION FROM MODEL TO PROTOTYPE IS CONSIDERED IN DETAIL. THE RESULTS OF ALL THREE EFFORTS ARE COMPARED, AND GOOD AGREEMENT IS SHOWN.
DESCRIPTORS	AERODYNAMICS: Q1;COMPARATIVE EVALUATIONS;EFFICIENCY; PERFORMANCE: Q1;POWER GENERATION;POWER RANGE 1-10 KW;TURBINE BLADES;WIND TURBINES: T1

W-38

ACCESSION NO.	79R0035572
TITLE(MONO)	WIND TURBINE GENERATOR SITING AND TV RECEPTION HANDBOOK. TECHNICAL REPORT NO. 1
EDITOR OR COMP	SENIOR, T.B.A.; SENGUPTA, D.L.
CORPORATE AUTH	MICHIGAN UNIV., ANN ARBOR (USA). RADIATION LAB.
PAGE NO	36
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EY-76-S-02-2846
DATE	JAN 1978
CATEGORIES	EDB-170500
PRIMARY CAT	EDB-170500
REPORT NO	COO--2846-1
ABSTRACT	THE ROTATING BLADES OF A HORIZONTAL AXIS WIND TURBINE GENERATOR (WTG) CAN DISTORT THE VIDEO PORTION OF A TV SIGNAL AND THEREBY INTERFERE WITH TV RECEPTION IN THE VICINITY OF THE WTG. THE NATURE OF THIS INTERFERENCE IS DISCUSSED AND METHODS ARE DESCRIBED FOR CALCULATING THE APPROXIMATE ZONE WITHIN WHICH THE INTERFERENCE IS JUDGED SEVERE. ALL NECESSARY INFORMATION IS PROVIDED FOR PREDICTING THE INTERFERENCE ZONES ABOUT MOD-0 AND MOD-0A, AND MOD-1 MACHINES FOR ANY GIVEN TV TRANSMITTER USING GRAPHICAL PROCEDURES. THE EFFECTS OF ANY TERRAIN INHOMOGENEITY, IRREGULARITY, OR ADJACENT STRUCTURES ARE IGNORED.
DESCRIPTORS	ELECTROMAGNETIC RADIATION;ENVIRONMENTAL IMPACTS: Q1;SITE SELECTION;TELEVISION;TOPOGRAPHY;WIND TURBINES: T1

W-39

ACCESSION NO.	79C0041797
TITLE(MONO)	MICROPROCESSOR CONTROL OF A WIND TURBINE GENERATOR
EDITOR OR COMP	GRECCO, A.J.; WHITEHEAD, G.T.
CORPORATE AUTH	DEPARTMENT OF ENERGY, WASHINGTON, DC (USA). OFFICE OF ENERGY TECHNOLOGY
SEC REPT NO	NASA-TM--79021
PAGE NO	29
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1028
CONF TITLE	CONFERENCE ON INDUSTRIAL APPLICATIONS OF MICROPORCESSORS
CONF PLACE	PHILADELPHIA, PA, USA
CONF DATE	20 MAR 1978
DATE	1978
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	DOE/NASA/1028--78/20
ABSTRACT	A MICROPROCESSOR BASED SYSTEM USED TO CONTROL THE UNATTENDED OPERATION OF A WIND TURBINE GENERATOR IS DESCRIBED. THE TURBINE AND ITS MICROCOMPUTER SYSTEM ARE FULLY DESCRIBED WITH SPECIAL EMPHASIS ON THE WIDE VARIETY OF TASKS PERFORMED BY THE MICROPROCESSOR FOR THE SAFE AND EFFICIENT OPERATION OF THE TURBINE. THE FLEXIBILITY, COST AND RELIABILITY OF THE MICROPROCESSOR WERE MAJOR FACTORS IN ITS SELECTION.
DESCRIPTORS	CONTROL EQUIPMENT;CONTROL SYSTEMS: T2,Q1;COST;ELECTRONIC EQUIPMENT;MICROPROCESSORS: T3,Q2;PERFORMANCE: Q3; SPECIFICATIONS: Q3;WIND TURBINES: T1

W-40 NONE

W-41

ACCESSION NO.	79R0001598
TITLE(MONO)	LARGE WIND TURBINE GENERATORS
EDITOR OR COMP	THOMAS, R.L.; DONOVAN, R.M.
CORPORATE AUTH	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH (USA). LEWIS RESEARCH CENTER
SEC REPT NO	NASA-TM--73767; CONF-780222--8
PAGE NO	36
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EG-77-A-29-1059
CONF TITLE	5. ENERGY TECHNOLOGY CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	27 FEB 1978
DATE	1978
CATEGORIES	EDB-170602;170400
PRIMARY CAT	EDB-170602
REPORT NO	DOE/NASA/1059--78/1
ABSTRACT	THE FEDERAL WIND PROGRAM IS REVIEWED. DESCRIPTIONS OF THE MOD-0, MOD-0A, MOD-1, MOD-1A, AND MOD-2 WIND TURBINE PROJECTS ARE PRESENTED. POWER PRODUCTION COSTS ARE CALCULATED.
DESCRIPTORS	ECONOMICS: Q2;NASA;PLANNING: Q2;POWER GENERATION; SPECIFICATIONS: Q1;US DOE;WIND POWER PLANTS: T2;WIND TURBINES: T1

W-42

ACCESSION NO.	76C0119744
REPORT NO,PAGE	CONF-770921--P1 PP. 156-166
TITLE	ANALYSIS OF THE ECONOMICS OF CURRENT SMALL WIND ENERGY SYSTEMS
AUTHORS	KORNREICH, T.R.; TOMPKINS, D.M.
AUTHOR AFF	JBF SCIENTIFIC CORP., ARLINGTON, VA
TITLE(MONO)	PROCEEDINGS OF THE THIRD BIENNIAL CONFERENCE AND WORKSHOP ON WIND ENERGY CONVERSION SYSTEMS. VOL. I
EDITOR OR COMP	KORNREICH, T.R. (ED.)
PAGE NO	156-166
CONF TITLE	3. BIENNIAL WIND ENERGY CONVERSION SYSTEMS CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	19 SEP 1977
DATE	MAY 1976
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	CONF-770921--P1
ABSTRACT	WIND ENERGY CONVERSION SYSTEMS WITH POWER RATINGS OF 15 KW OR LESS, REFERRED TO AS SMALL WECS, HAVE BEEN SOLD FOR SEVERAL YEARS BY MANUFACTURERS IN EUROPE AND THE UNITED STATES. IN RECENT YEARS, DUE TO COST INCREASES AND UNCERTAINTIES IN THE SUPPLIES OF FOSSIL FUELS, ADDITIONAL MANUFACTURERS HAVE ENTERED THIS FIELD. THE ERDA WIND SYSTEMS BRANCH IS CARRYING OUT TESTS OF EXISTING SMALL WECS, DEVELOPMENT OF NEW DESIGNS AND PLANNING FOR METHODS TO EXPAND THE COMMERCIAL MANUFACTURE AND UTILIZATION OF SMALL WECS. THIS REPORT PRESENTS A REVIEW OF THE PERFORMANCE AND ECONOMICS OF CURRENTLY AVAILABLE SMALL WECS AND PROVIDES AN INDICATION OF HOW WELL THESE SYSTEMS COMPETE WITH ALTERNATIVE ENERGY SOURCES IN CERTAIN APPLICATIONS AT TODAY'S TECHNOLOGY AND COMMERCIAL STATUS. IT SHOULD BE POINTED OUT THAT WECS COSTS DO NOT INCLUDE THE EFFECTS OF R AND D WHICH MIGHT LEAD TO BETTER MACHINES AS MEASURED BY PERFORMANCE AND COST.
DESCRIPTORS	COMPARATIVE EVALUATIONS: Q1;COST;ECONOMICS: Q1;EFFICIENCY; PERFORMANCE: Q1;POWER GENERATION;POWER RANGE 1-10 KW;POWER RANGE 10-100 KW;WIND TURBINES: T1

W-43

ACCESSION NO.	78R0101262
TITLE(MONO)	DESIGN STUDY OF WIND TURBINES 50 KW TO 3000 KW FOR ELECTRIC UTILITY APPLICATIONS: ANALYSIS AND DESIGN
CORPORATE AUTH	KAMAN AEROSPACE CORP., BLOOMFIELD, CONN. (USA)
SEC REPT NO	NASA-CR--134937; R--1382
PAGE NO	567
AVAILABILITY	DEP. NTIS, PC A24/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1010
DATE	FEB 1976
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	DOE/NASA--9404-76/2
ABSTRACT	THE OBJECTIVE OF THE CONTRACT WAS TO DEVELOP OPTIMIZED PRELIMINARY DESIGNS OF LOW POWER (50 TO 500 KW) AND HIGH POWER (500 TO 3000 KW) WIND GENERATOR SYSTEMS (WGS) FOR ELECTRIC UTILITY APPLICATIONS. THE LOW POWER SYSTEM IS DESIGNED FOR A UTILITY SITE WITH A YEARLY MEDIAN WIND SPEED OF 5.4 M/SEC (12 MPH) AND THE HIGH POWER WGS IS DESIGNED FOR A UTILITY SITE WITH AN 8 M/SEC (18 MPH) MEDIAN WIND SPEED. THE PRELIMINARY DESIGNS PREPARED IN THE STUDY ARE INTENDED TO PROVIDE THE BASES FOR FOLLOW-ON PROGRAMS WHICH WILL INVOLVE THE DETAIL DESIGN, FABRICATION AND EXPERIMENTAL DEMONSTRATION TESTING OF THESE UNITS AT SELECTED UTILITY SITES.
DESCRIPTORS	COMPARATIVE EVALUATIONS: Q2;CONTROL SYSTEMS;COST: Q1;DESIGN; ECONOMICS;MECHANICAL VIBRATIONS;PERFORMANCE;POWER GENERATION: Q1;POWER RANGE 1-10 MW;POWER RANGE 10-100 KW;POWER RANGE 100-1000 KW;POWER SYSTEMS;SPECIFICATIONS: Q2;STRESS ANALYSIS; WIND POWER PLANTS: T1;WIND TURBINES: T2

W-44

ACCESSION NO.	78C0095128
REPORT NO.PAGE	CONF-740855--P1 PP. 2.37-2.58
TITLE	SOME MARKETING AND TECHNICAL CONSIDERATIONS OF WIND POWER
AUTHORS	LISSAMAN, P.B.S.
AUTHOR AFF	AEROVIRONMENT INC., PASADENA, CA
TITLE(MONO)	ADVANCED WIND ENERGY SYSTEMS. VOLUME I. WORKSHOP PROCEEDINGS
EDITOR OR COMP	LJUNGSTROEM, O. (ED.)
PAGE NO	2.37-2.58
CONF TITLE	CONFERENCE ON WIND ENERGY
CONF PLACE	STOCKHOLM, SWEDEN
CONF DATE	29 AUG 1974
DATE	1976
CATEGORIES	EDB-170602;170400
PRIMARY CAT	EDB-170602
REPORT NO	CONF-740855--P1
ABSTRACT	A BRIEF REVIEW OF THE WIND POWER MARKET SITUATION IS GIVEN. THREE VIABLE WINDMILL CLASSES ARE IDENTIFIED IN THE POWER RANGES OF 0.1, 1, AND 1000 KW. JUDGING BY THE PUBLIC RESPONSE, AND SOME VERY PRELIMINARY MARKET SURVEYS, THE DEMAND FOR THE TWO SMALLER UNITS APPEARS ATTRACTIVE FOR PRIVATE VENTURE CAPITAL. SOME COMMON CHARACTERISTICS OF POTENTIAL PURCHASERS FOR THE 1 TO 5 KW SYSTEMS ARE IDENTIFIED. A BASIC AERODYNAMIC PERFORMANCE ANALYSIS FOR THE CROSSWIND TYPE ROTOR IS OUTLINED, SHOWING THAT IT IS INTRINSICALLY LESS EFFICIENT AERODYNAMICALLY THAN THE WIND AXIS (PROPELLER) ROTOR. A GREATLY SIMPLIFIED STRUCTURAL COMPARISON IS MADE, ALSO SHOWING THE CROSSWIND TYPE TO BE COMPARABLE BUT SLIGHTLY LESS EFFICIENT STRUCTURALLY THAN THE PROPELLER TYPE.
DESCRIPTORS	AERODYNAMICS: Q1;COMPARATIVE EVALUATIONS;ECONOMICS: Q1; EFFICIENCY;MARKET: Q1;PERFORMANCE;WIND TURBINES: T1

W-45

ACCESSION NO.	78C0095117
REPORT NO.PAGE	CONF-740855--P2 PP. 6.29-6.35
TITLE	WIND ENERGY: COST EFFECTIVENESS IS THE KEY
AUTHORS	MCCARTHY, C.D.; ROSEN, G.
AUTHOR AFF	HAMILTON STANDARD, WINDSOR LOCKS, CT
TITLE(MONO)	ADVANCED WIND ENERGY SYSTEMS. VOLUME II. WORKSHOP PROCEEDINGS
EDITOR OR COMP	LJUNGSTROEM, O. (ED.)
PAGE NO	6.29-6.35
CONF TITLE	CONFERENCE ON WIND ENERGY
CONF PLACE	STOCKHOLM, SWEDEN
CONF DATE	29 AUG 1974
DATE	1976
CATEGORIES	EDB-170400
PRIMARY CAT	EDB-170400
REPORT NO	CONF-740855--P2
ABSTRACT	THE COST ANALYSIS FOR WIND TURBINE BLADES IS PRESENTED.
DESCRIPTORS	COST;DESIGN;ECONOMICS: Q1;PERFORMANCE;TURBINE BLADES;WIND TURBINES: T1

W-46

ACCESSION NO.	78C0095115
REPORT NO.PAGE	CONF-740855--P1 PP. 2.101-2.131
TITLE	REDUCTION OF WIND POWERED GENERATOR COST BY USE OF A ONE BLADED ROTOR
AUTHORS	PHUYN, R.R.; WIESNER, W.
AUTHOR AFF	BOEING VERTOL CO., PHILADELPHIA
TITLE(MONO)	ADVANCED WIND ENERGY SYSTEMS. VOLUME I. WORKSHOP PROCEEDINGS
EDITOR OR COMP	LJUNGSTROEM, O. (ED.)
PAGE NO	2.101-2.131
CONF TITLE	CONFERENCE ON WIND ENERGY
CONF PLACE	STOCKHOLM, SWEDEN
CONF DATE	29 AUG 1974
DATE	1976
CATEGORIES	EDB-170400;170602
PRIMARY CAT	EDB-170400
REPORT NO	CONF-740855--P1

ABSTRACT	COST ANALYSIS SUPPORTED BY PRELIMINARY DESIGN STUDIES OF ONE AND TWO BLADED WIND POWERED GENERATOR UNITS SHOWS THAT A 30% REDUCTION IN ACQUISITION COST CAN BE ACHIEVED WITH A ONE BLADED DESIGN. DESIGNS STUDIED WERE SIZED FOR AN OUTPUT POWER OF 1000 KILOWATTS. THE ONE BLADED DESIGN HAS THE POTENTIAL FOR REDUCING ACQUISITION COST TO $680 PER AVAILABLE KILOWATT IF THE UNIT IS LOCATED IN A REGION WITH MEAN SURFACE WINDS OF 15 MPH. VIBRATORY LOADS OF THE ONE BLADED DESIGN ARE SIGNIFICANT AND WILL REQUIRE CONSIDERABLE DESIGN ATTENTION. THE ONE PER REV CORIOLIS TORQUE CAUSED BY BLADE FLAPPING IS THE MOST SIGNIFICANT PROBLEM. THE MAJOR SOURCE OF BLADE FLAPPING WILL BE THE VELOCITY GRADIENT OF THE GROUND BOUNDARY LAYER. A TORSIONAL VIBRATION ISOLATING COUPLING MAY BE REQUIRED IN THE GENERATOR DRIVE TO REDUCE THE LOADS DUE TO THIS VIBRATORY TORQUE. AN INCLINED FLAPPING HINGE ALSO IS DESIRABLE TO CAUSE PITCH-FLAP COUPLING THAT WILL SUPPRESS BLADE FLAP MOTIONS.
DESCRIPTORS	AERODYNAMICS;CONFIGURATION;COST: 01;MECHANICAL VIBRATIONS; PERFORMANCE: 01;WIND TURBINES: T1

W-47

ACCESSION NO.	78B0085142
TITLE(MONO)	HARNESSING THE WIND FOR HOME ENERGY
EDITOR OR COMP	MCGUIGAN, D.
PAGE NO	141
AVAILABILITY	$4.95
PUBL LOC	GARDEN WAY ASSOCIATES, INC., CHARLOTTE, VT
DATE	1978
ISBN CODE	ISBN 0-88266-118-3
CATEGORIES	EDB-299003;170602
PRIMARY CAT	EDB-299003
ABSTRACT	INFORMATION ON THE USE OF WIND TURBINE ELECTRIC GENERATORS FOR HOME POWER SUPPLY IS PRESENTED CONCERNING WIND MEASUREMENT, TURBINE PLACEMENT, SPECIFICATIONS AND COST COMPARISONS FOR AVAILABLE WIND TURBINES, EXAMPLES OF WIND TURBINE ELECTRIC GENERATORS APPLIED TO HOUSE POWER SYSTEMS, AND LISTINGS OF EQUIPMENT MANUFACTURERS.
DESCRIPTORS	COST: 01;HOUSES: T2;PERFORMANCE;PLANNING: 03;POWER GENERATION; POWER SUPPLIES: T3,02;SPECIFICATIONS: 01;WIND TURBINES: T1,03 01,03,04;FOSSIL-FUEL POWER PLANTS;GAS TURBINES;HYDROELECTRIC POWER PLANTS;LOAD MANAGEMENT: M5;NUCLEAR FUELS;NUCLEAR POWER PLANTS;PERFORMANCE;PLANNING: 05;POWER GENERATION: M1;POWER TRANSMISSION: M3;PUMPED STORAGE;REGULATIONS;REVIEWS: 01,03; STEAM GENERATION

W-48

ACCESSION NO.	78Y0078676
TITLE	LOW-COST CONCEPT FOR THE ENERGY SUPPLY FROM THE WIND
AUTHORS	GOSLICH, H.D.
AUTHOR AFF	INGENIEURBUERO H.D. GOSLICH, HAMBURG (GERMANY, F.R.)
TITLE(MONO)	1ST GERMAN SOLAR ENERGY FORUM. VOL. 2. PROCEEDINGS. CHAPTER IV: WIND ENERGY
EDITOR OR COMP	BUSSEL, U. (ED.)
PAGE NO	425-436
CONF TITLE	1. GERMAN SOLAR FORUM WITH EXHIBITION
CONF PLACE	HAMBURG, GERMANY, F.R.
CONF DATE	26 - 28 SEP 1977
PUBL LOC	DGS, MUENCHEN, GERMANY, F.R.
DATE	1977
LANGUAGE	IN GERMAN
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
ABSTRACT	AFTER A NUMBER OF YEARS OF PRACTICAL EXPERIENCE WITH WINDMILLS (TWO-ROTOR KW AT SYLT; 11 KW, 10 METER DIAMETER AND ALSO SMALLER PLANTS AT HAMBURG) TWO-BLADE, HIGH R.P.M. PLANTS WERE DESIGNED WITH THE ROTOR ON THE LEE SIDE OF THE TOWER, BOTH IN ORDER TO SINK SIGNIFICANTLY THE CONSTRUCTION AND MAINTENANCE COST AND TO INCREASE THE LIFE OF THE WINDMILL. THE ROTOR BLADES ARE JOINTED AT THE HUB AND ROTATE ON A 'SPHERICAL RADIUS' DURING PERIODS OF HIGH WIND VELOCITY. FULL POWER IS PRODUCED DURING STORMY PERIODS. A CONCEPT OF LARGE SCALE POWER GENERATION, ALONG WITH COST COMPARISONS, WILL BE DESCRIBED.
DESCRIPTORS	COMPARATIVE EVALUATIONS;COST;DESIGN: 01;ECONOMICS;POWER GENERATION;WIND TURBINES: T1

W-49

ACCESSION NO.	78J0030276
TITLE	BOUNTY IN THE BREEZE
AUTHORS	WISE, C.E.
PUB DESC	MACH. DES., V. 49, NO. 16, PP. 20-22, 24-26
DATE	11 AUG 1977
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
ABSTRACT	POWERFUL NEW VERSIONS OF THE TRADITIONAL WINDMILL ARE BEING BUILT UNDER CONTRACT TO ERDA. DESIGNED TO PRODUCE UP TO 2.5 MW OF ELECTRIC POWER, THEY ARE ''TRADITIONAL'' ONLY IN THAT THEY USE WHIRLING BLADES. SOME OF THE MORE ADVANCED MODELS MAY BRING BREAKTHROUGHS IN SIZE, POWER OUTPUT, AND EFFICIENCY.
DESCRIPTORS	CONTRACTS;DESIGN;ELECTRIC POWER;ENERGY EFFICIENCY;POWER GENERATION;TURBINE BLADES;US ERDA;WIND TURBINES: T

W-50

ACCESSION NO.	78R0030274
TITLE(MONO)	DESIGN STUDY OF WIND TURBINES 50 KW TO 3000 KW FOR ELECTRIC UTILITY APPLICATIONS. VOLUME 1. SUMMARY REPORT
CORPORATE AUTH	GENERAL ELECTRIC CO., PHILADELPHIA, PA. (USA)
SEC REPT NO	NASA-CR--134934; GE-SD--76SDS4267
PAGE NO	64
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1010-005
DATE	SEP 1976
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	ERDA/NASA/9403--76/1
ABSTRACT	THIS STUDY WAS ONE OF TWO PARALLEL EFFORTS CONDUCTED TO DEFINE THE WIND TURBINE CONFIGURATION THAT WOULD LEAD TO GENERATION OF ELECTRICAL POWER IN A COST EFFECTIVE MANNER. ALL POSSIBLE OVERALL SYSTEM CONFIGURATIONS, OPERATING MODES, AND SUBSYSTEM CONCEPTS WERE EVALUATED FOR BOTH TECHNICAL FEASIBILITY AND COMPATIBILITY WITH UTILITY NETWORKS, AS WELL AS FOR ECONOMIC ATTRACTIVENESS. A DESIGN OPTIMIZATION COMPUTER CODE WAS DEVELOPED TO DETERMINE THE COST SENSITIVITY OF THE VARIOUS DESIGN FEATURES, AND THUS ESTABLISH THE CONFIGURATION AND DESIGN CONDITIONS THAT WOULD MINIMIZE THE GENERATED ENERGY COSTS. THE PRELIMINARY DESIGNS OF BOTH A 500 KW UNIT AND A 1600 KW UNIT OPERATING IN A 12 MPH AND 18 MPH MEDIAN WIND SPEED RESPECTIVELY, WERE DEVELOPED. THIS REPORT SUMMARIZES BOTH THE RATIONALE EMPLOYED IN THIS STUDY AND THE KEY FINDINGS OF THIS STUDY, BUT DOES, NOT PRESENT AN IN-DEPTH DETAIL DISCUSSION OF ALL DESIGN CONSIDERATIONS.
DESCRIPTORS	CONFIGURATION;COST;ECONOMICS: Q2;EFFICIENCY;ELECTRIC POWER; OPTIMIZATION;POWER GENERATION: Q2;SPECIFICATIONS: Q1;WIND POWER PLANTS: T2;WIND TURBINES: T1

W-51

ACCESSION NO.	78C0073461
TITLE(MONO)	PRELIMINARY RESULTS OF THE LARGE EXPERIMENTAL WIND TURBINE PHASE OF THE NATIONAL WIND ENERGY PROGRAM
EDITOR OR COMP	THOMAS, R.L.; SHOLES, J.E.
CORPORATE AUTH	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OHIO (USA). LEWIS RESEARCH CENTER
SEC REPT NO	CONF-751042--2; NASA-TM-X--71796
PAGE NO	15
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1004
CONF TITLE	CONFERENCE ON FRONTIERS OF POWER TECHNOLOGY
CONF PLACE	STILLWATER, OK, USA
CONF DATE	1 OCT 1975
DATE	1975
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	DOE/NASA/1004--77/9
ABSTRACT	A MAJOR PHASE OF THE WIND ENERGY PROGRAM IS THE DEVELOPMENT OF RELIABLE WIND TURBINES FOR SUPPLYING COST-COMPETITIVE ELECTRICAL ENERGY. THE PRELIMINARY RESULTS OF TWO PROJECTS IN THIS PHASE OF THE PROGRAM ARE DISCUSSED. FIRST AN EXPERIMENTAL 100 KW WIND TURBINE DESIGN AND ITS STATUS ARE REVIEWED. ALSO DISCUSSED ARE THE RESULTS OF TWO PARALLEL DESIGN STUDIES, FOR DETERMINING THE CONFIGURATIONS AND POWER LEVELS FOR WIND TURBINES WITH MINIMUM ENERGY COSTS. THESE STUDIES SHOW WIND ENERGY COSTS OF 7 TO 1.5 CENTS/KWH FOR WIND TURBINES PRODUCED IN QUANTITIES OF 100 TO 1000 A YEAR AND LOCATED AT SITES HAVING AVERAGE WINDS OF 12 TO 18 MPH.
DESCRIPTORS	ECONOMICS: Q2;NASA: T1;OPERATION: Q2;PERFORMANCE;POWER GENERATION;POWER RANGE 100-1000 KW;US DOE;WIND TURBINES: T2,Q1

W-52

ACCESSION NO.	78C0053620
TITLE(MONO)	WIND TURBINE GENERATOR ROTOR BLADE CONCEPTS WITH LOW COST POTENTIAL
EDITOR OR COMP	SULLIVAN, T.L.; CAHILL, T.P.; GRIFFEE, D.G. JR.; GEWEHR, H.W.
CORPORATE AUTH	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OHIO (USA). LEWIS RESEARCH CENTER
SEC REPT NO	CONF-760502--1; NASA-TM--73636
PAGE NO	40
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EX-76-A-29-1028
CONF TITLE	23. NATIONAL SAMPE SYMPOSIUM
CONF PLACE	ANAHEIM, CA, USA
CONF DATE	2 MAY 1976
DATE	DEC 1977
CATEGORIES	EDB-170602
PRIMARY CAT	EDB-170602
REPORT NO	DOE/NASA/1028--77/13
ABSTRACT	FOUR PROCESSES FOR PRODUCING BLADES ARE EXAMINED. TWO USE FILAMENT WINDING TECHNIQUES AND TWO INVOLVE FILLING A MOLD OR FORM TO PRODUCE ALL OR PART OF A BLADE. THE PROCESSES ARE DESCRIBED AND A COMPARISON IS MADE OF COSTS, MATERIAL PROPERTIES, DESIGNS AND FREE VIBRATION CHARACTERISTICS. CONCLUSIONS ARE MADE REGARDING THE FEASIBILITY OF EACH PROCESS TO PRODUCE LOW COST, STRUCTURALLY ADEQUATE BLADES.
DESCRIPTORS	COST: Q2;FABRICATION: Q2;FEASIBILITY STUDIES;PERFORMANCE; STRESSES;TURBINE BLADES: T2,Q1;WIND TURBINES: T1

W-53 NONE
W-54 NONE
W-55 NONE

W.56 "Low Cost Composite Blades for Large Wind Turbines", Perry, D.J. and Weingart, O. AIAA-SERI Wind Energy Conference Paper No. AIAA-80-0634-CP, April, 1980.

W.57 "Fabrication of Large Composite Spars and Blades", Weingart, O. 35th Annual Technical Conference Reinforced Plastics/Composites Institute, 1980.

W.58 "Development of 4 kW Wind Turbine Generator", Bottrell, G. and Sullivan, L.J. Proceedings 15th Intersociety Energy Conversion Engineering Conference, Seattle, August, 1980.

BATTERY ENERGY CONVERSION SYSTEMS

Analysis

The following seven battery energy conversion systems were considered:

- Lead-acid
- Na/S
- Ni/Fe
- Zn/Cl_2
- Zn/Br_2
- $Li-Al/FeS_2$
- Redox (Fe-Cr)

Adequacy of data for analysis of quantitative system parameters as summarized in Table 61. Where data are scarce, best judgement is used in determining values of quantitative system parameters. Lack of data availability is due to, with the exception of lead-acid batteries, the fact that these battery technologies are under development.

Data used in the analysis of quantitative system parameters of efficiency, acquisition cost, weight, volume, footprint, lifetime, and temperature of battery energy conversion systems are summarized in Table 62.

Battery energy conversion systems are modular and thus certain quantitative parameters may not be correlated to system size (kWhr) or capacity (kW). Where data are adequate to perform a meaningful statistical analysis, parameter values are stated with a value for standard deviation. When data are limited, a value for the parameter is stated with a range. In cases of limited data availability, values stated are based on best judgement. Applying appropriate data analysis techniques resulted in the following values for quantitative system parameters.

Table 61. DATA AVAILABILITY FOR BATTERY ENERGY CONVERSION SYSTEMS

Parameter	Data Availability: Adequate	Data Availability: Scarce	Data Availability: Not available
Efficiency	Lead-acid Ni/Fe Na/S Redox	Zn/Cl_2 $Li\text{-}Al/FeS_2$	$ZnBr_2$
Acquisition Cost	Lead-acid	Ni/Fe $Li\text{-}Al/FeS_2$	Zn/Cl_2 Zn/Br_2 Redox Na/S
Operations and Maintenance Cost			Lead-acid Na/S Ni/Fe Zn/Cl_2 Zn/Br_2 $Li\text{-}Al/FeS_2$ Redox
Weight (Specific Energy)	Lead-acid Ni/Fe	Zn/Cl_2 Zn/Br_2 Na/S	$Li\text{-}Al/FeS_2$ Redox
Weight (Specific Power)	Lead-acid Ni/Fe	Zn/Cl_2 Zn/Br_2	Na/S $Li\text{-}Al/FeS_2$ Redox
Volume/Size/Footprint	Lead-acid Ni/Fe	Zn/Cl_2	Zn/Br_2 Na/S Redox $Li\text{-}Al/FeS_2$
Start-Up/Shutdown Time			All technologies
Lifetime	Lead-acid Ni/Fe $Li\text{-}Al/FeS_2$	Zn/Cl_2 Redox Na/S	Zn/Br_2
Temperature	Lead-acid Na/S Ni/Fe Zn/Cl_2 Zn/Br_2 $Li\text{-}Al/FeS_2$		Redox

Table 62. DATA USED IN THE ANALYSIS OF PARAMETERS OF EFFICIENCY, ACQUISITION COST, WEIGHT, VOLUME, FOOTPRINT, LIFETIME, AND TEMPERATURE OF BATTERY ENERGY CONVERSION SYSTEMS

Battery Technology	Efficiency (%)	Acquisition Cost ($/kWhr)	Weight-Specific Energy (Whr/lb)	Weight-Specific Power (Whr/lb)	Volume (Whr/ft^3)	Footprint (Whr/ft^2)	Lifetime (cycles)	Temperature (°F)
Lead Acid	80	70	13.6	81.8	2.81		700	-31°F to 160°F
	75	73.5	21.1	81.8	3.18		500	-4°F to 120°F
	83	121	11.6	67.0	1.51		270	
		126	15.0	112.0	3.07		500	
		98	15.2	47.7	2.93			
			12.5		2.12			
			11.6					
			13.3					
			15.0					
			17.0					
			19.3					
			18.6					
Na/S	70		40.9				200	570 to 662
	76.8		49.6				200	570 to 707
	75.2						1,000	570 to 662
							700	570 to 662
							10,000	500 to 930
								500 to 700
Ni/Fe	62.5	1300 (goal)	20	54.5 @ 20 sec	3.00		800	-40 to 176
	50	1305 (goal)	22.7	50 @ 30 sec	3.39		1,500	50 to 120
	55	544 (goal)	20.9	50 @ 30 sec	3.53		1,700	Above 50
	70		21.8	46.8 @ 1800 sec			1,500	
	66							
	60							
Zn/Cl_2	60.3		22.7	31.8	220 (utility)	7,200	1,250	104 to 122
					3830 (EV)		500	86 to 113
					3760 (EV)			
Zn/Br_2			31.8	36.4				120
			29.6	45.5				
			27.3					
Li-Al/FeS_2	75	>2000	45.5				250	806 to 887
	81.9		35.2				300	842
							258	
Redox	81							
	75							
	65							

Lead Acid Battery Efficiency (PBEFF)

PBEFF = 79%

Range = 4%

Based on limited operating plant data.

Na/S Battery Efficiency (NAEFF)

NAEFF = 74%

Range = 2%

Ni/Fe Battery Efficiency (NIEFF)

NIEFF = 60.6%

Standard Deviation = 7.3%

Based on operating plant data.

Zn/Cl_2 Battery Efficiency (CLEFF)

CLEFF = 60%

Based on one data point value. Must be used cautiously in design.

Li-Al/FeS_2 Battery Efficiency (LIEFF)

LIEFF = 78.5%

Range = 3%

Experimental battery. Limited data.

Redox Battery Efficiency (REEFF)

REEFF = 73.7%

Range = 7%

Experimental battery. Limited data.

Efficiency values are for the battery only and do not include efficiencies of charging components or of power conditioning equipment necessary to serve a load.

Lead Acid Battery Acquisition Cost (PBC)

PBC = \$97.7/kWhr

Standard Deviation = \$26.0/kWhr

Based on operating plant data.

Ni/Fe Battery Acquisition Costs (NIC)

NIC = \$950/kWhr

Range = \$450/kWhr

Not commercially available. Acquisition cost based on DOE goals for limited production of experimental batteries. Use with caution in design.

Li-Al/FeS_2 Battery Acquisition Cost (LIA)

LIA = \$2000/kWhr

Not commercially available. Experimental status. Use with caution in design.

Lead Acid Battery Weight — Specific Energy (PBSE)

PBSE = 15.3 Whr/lb

Standard Deviation = 3.1 Whr/lb

Based on 3 to 5-hour discharge rate to 80% depth of discharge (DOD). Longer discharge times increase specific energy. Specific energy is decreased for short discharge times.

Na/S Battery Weight — Specific Energy (NASE)

NASE = 45.2 Whr/lb

Range = 5.0 Whr/lb

Based on limited data on experimental cells.

Ni/Fe Battery Weight — Specific Energy (NISE)

NISE = 21.4 Whr/lb

Standard Deviation = 1.2 Whr/lb

Zn/Cl_2 Battery Weight — Specific Energy (ZCSE)

ZCSE = 22.7 Whr/lb

Based on one data point.

Zn/Br_2 Battery Weight — Specific Energy (ZBSE)

ZBSE = 29.6 Whr/lb

Range = 2.0 Whr/lb

Not based on operating batteries. Based on 1980 design specifications for electric vehicle batteries.

$Li\text{-}Al/FeS_2$ Battery Weight — Specific Energy (LISE)

LISE = 40 Whr/lb

Range = 5 Whr/lb

Based on limited data on experimental cells.

Lead Acid Battery Weight — Specific Power (PBSP)

PBSB = 78.1 W/lb

Standard Deviation = 23.6 W/lb

Based on operating plant data. Variation dependent on discharge time. High values of specific power for short discharge times. Long discharge times lead to lower specific power values.

Ni/Fe Battery Weight — Specific Power (NISP)

NISP = 50 W/lb

Range = 5 W/lb

Based on operating plant data.

Zn/Cl_2 Battery Weight — Specific Power (ZCSP)

ZCSP = 31.8 W/lb

One data point. Use with caution in design.

Zn/Br_2 Battery Weight — Specific Power (ZBSP)

ZBSP = 41.0 W/lb

Range = 4.5 W/lb

Based on 1980 electric vehicle design specification. Use with caution in design.

Lead Acid Battery Volume (PBV)

PBV = 2.60 Whr/ft^3

Standard Deviation = 0.65 Whr/ft^3

Ni/Fe Battery Volume (NIV)

NIV = 3.3 Whr/ft^3

Standard Deviation = 0.3 Whr/ft^3

Zn/Cl_2 Battery Volume (ZCV)

ZCVU = 220 Whr/ft^3

Design point for utility peakshaving plant (100 MWhr). Single data point based on experimental module.

ZCVEV = 3790 Whr/ft^3

Range = 35 Whr/ft^3

Two data points for electric vehicle experimental batteries. Values for ZCVU and ZCVEV must be used with caution in design.

Zn/Cl_2 Battery Footprint (ZCFU)

ZCFU = 7.2 $kWhr/ft^2$

Single data point. Based on design for utility peakshaving (100 MWhr) battery. Use with caution in design.

Lead Acid Battery Cycle Lifetime (PBCL)

PBCL = 500 cycles

Range = 200 cycles

Na/S Battery Cycle Lifetime (NACL)

NACL = 1000 cycles

Range = 300 cycles

Cycle lifetime values range from 200 to 10,000 cycles. NACL should be used with caution in design.

Ni/Fe Battery Cycle Lifetime (NICL)

NICL = 1375 cycles

Standard Deviation = 395 cycles

Based on operating plant data.

Zn/Cl_2 Battery Cycle Lifetime (ZCCL)

ZCCL = 1000 cycles

Based on engineering judgement from limited data on experimental cells. ZCCL should be used with caution in design.

$Li\text{-}Al/FeS_2$ Battery Cycle Lifetime (LICL)

LICL = 270 cycles

Range = 20 cycles

Limited data. LICL should be used with caution in design.

Redox Battery Cycle Lifetime (RECL)

RECL = 3000 cycles

One data point for experimental battery. Lifetime testing is continuing

Lead Acid Battery Operating Temperature (PBT)

PBT = 64.5°F

Range = 95.5°F

Na/S Battery Operating Temperature (NAT)

NAT = 635°F

Range = 65°F

Ni/Fe Battery Operating Temperature (NIT)

NIT = 85°F

Range = 35°F

Zn/Cl_2 Battery Operating Temperature (ZCT)

ZCT = 104°F

Range = 18°F

Zn/Br_2 Battery Operating Temperature (ZBT)

ZBT = 120°F

Li-Al/FeS_2 Battery Operating Temperature (LIT)

LIT = 845°F

Range = 45°F

Thermal Energy Available

Lead acid, Ni/Fe, Zn/Cl_2, Zn/Br_2, and redox battery energy conversion systems operate below 150°F and consequently produce waste heat at temperatures too low to be of value. Na/S batteries operate at 635°F, and Li-Al/FeS_2 operates at 845°F. These two battery technologies produce heat at useful temperatures. However, they are efficient (efficiency about 75%), and whatever heat is produced is used to maintain operating temperature against heat loss to ambient. Thus only a small amount of thermal energy may be available from Na/S and Li-Al/FeS_2 battery systems.

Mobility

Batteries are modular systems. As such they have high mobility. However, energy density is low as compared to alternatives such as a fuel-fired diesel engine. Considering battery energy storage density alone, a 50,000 pound load would correspond to an energy capacity between 760 and 2000 kWhr. This is the equivalent of 94 to 250 gallons of distillate fuel oil converted to electricity at 20 percent efficiency. The weight of balance of system components further reduces the amount of energy that may be transported. Overall assessment is that mobility is high, but the amount of energy that can be mobilized is low.

Availability of Raw Materials

- Lead Acid Battery. No problem. Materials are readily available.
- Na/S Battery. Sodium and sulfur are readily available. However, containment material alternatives are stainless steel (contains chromium), titanium, or aluminum. Chromium is limited in abundance and 91% of U.S. needs were imported in 1980. Chromium has strategic value. Chromium may be a problem. Titanium resources are adequate. One hundred percent of U.S. needs were imported in 1980. Titanium has strategic value. Titanium may be a problem. Aluminum is abundant but 86% of U.S. aluminum (as bauxite ore) was imported in 1970. Aluminum also has strategic value.

- Ni/Fe Battery. Nickel and iron are plentiful. However, lithium and cobalt are additives. Lithium supply is a minor problem. However, cobalt has strategic value and 93% was imported in 1980. Overall assessment is that raw materials are available for the Ni/Fe battery.

- Zn/Cl_2 Battery. Chlorine is available. Zinc is available but substantial amounts of zinc are imported. The positive electrode of the battery is a titanium substrate coated with ruthenium. Although titanium resources are adequate, titanium is a strategic material. All titanium is imported. Ruthenium is available, but all must be imported. Ruthenium has significant strategic value.

- Zn/Br_2 Battery. Bromine is available. Zinc is available but mostly imported. The positive electrode is ruthenium-coated titanium. Both materials are in adequate supply, but have significant strategic value.

- $Li\text{-}Al/FeS_2$ Battery. Iron and sulfur are available. Although most aluminum raw material is imported, aluminum availability is no problem. However, lithium availability could be a problem. "It is estimated that the lithium cost will account for about 50% of the $Li\text{-}Al/FeS_2$ material cost. If the projected commercialization of the total system is undertaken in the U.S.A., then by the year 2000, 15% of the known U.S. resources (5% of world resources) would be in use. Lithium recycling could be used to reduce demand in the same manner that lead is presently being recycled. Use of the above proportion of known resources would provide storage batteries for 20 million electric vehicles (EV) and 3,500 utility load-levelling plants of 100 MWh capacity."*

- Redox Battery. Iron is available. Chromium is a limited resource of considerable strategic value of which 91% was imported in 1980.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 63, 64, 65, and 66, respectively.

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* Murphy, D. W., J. Broadhead, and B. C. H. Steele. "Proceedings of a NATO Conference on Materials for Advanced Batteries." Sept. 9-14, 1979. Aussois, France. Plenum Press, New York (1980).

Table 63. BATTERY ENERGY CONVERSION SYSTEM
LOCATION CONSTRAINTS

Constraint	Effect	Remarks
1. Water Requirements	O	Highly distilled water used as electrolyte in some battery types.
2. Manning Requirements	O	
3. Fuel Availability and Delivery	●	Electricity is the fuel.
4. Fuel Storage	—	Not applicable.
5. Other	●	Safety is prime consideration. for siting. Chlorine or bromine leaks are possible with Zn/Cl_2 and Zn/Br_2 batteries. Leaks from Na/S and $Li-Al/FeS_2$ can be serious. Lead acid batteries give off hydrogen and oxygen which can be explosive.

Overall Assessment: The ordinal score is 3 indicating average locational constraints.

Table 64. BATTERY ENERGY CONVERSION SYSTEM
OPERATIONAL CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability and Efficiency	O	
2. Overload Capability	●	No overload capability except as designed.
3. Load Following Capability	O	

Overall Assessment: The ordinal score is 3 indicating average turn-down capability.

Table 65. BATTERY ENERGY CONVERSION
SYSTEM RELIABILITY

Constraint	Effect	Remarks
1. Moving Parts	O	Very few moving parts in battery energy conversion systems.
2. Operating Temperature	●	A moderate constraint with Na/S and Li-Al/FeS_2 batteries. Not a constraint for other batteries.
3. Modularity of Design	●	
4. Stress Levels	O	
5. Corrosion	●	Corrosion may be a problem. Resolved by careful material selection.
6. Other	●	Cycling not a constraint for low-temperature batteries. Does affect Na/S and Li-Al/FeS_2.

Overall Assessment: The ordinal score is 3 indicating average reliability.

Table 66. BATTERY ENERGY CONVERSION SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emission	Degree of Difficulty Amount of Emissions With Controls	In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	0	0	0	
• Air Pollution				
CO	—	—	—	
NO_x	—	—	—	
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Other	—	—	—	
• Noise	0	0	0	Inherently quiet
• Odor	—	—	—	
• Solid Waste	—	—	—	Closed system
• Chemical Waste	0	0	0	

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

BATTERY ENERGY CONVERSION SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Zn/Cl_2 - Battery

Parameter: Efficiency

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 1	63%	48% 59.4% (60.3%*)	45kWh	*When refurbished
B. 7	74.3% coulombic 87.8% voltaic 65.2% total (electrochem)			
B. 23	65% Electro-chemical 55% overall Including Auxiliaries		50.4kWh	EV battery
	>65% overall			Load levelling
B. 52	65.2% Electro-chemical (87.8% voltaic 74.3 coulombic)			Design cost study
B. 109		48.7%		Experimental 45 kWh battery. Utility peak shaving duty. DC to DC March, 1978.
	63.3%			Goal. Expermental 45 kWh battery. DC to DC.

Energy Conversion System: Zn/Cl_2 (Zinc/Chlorine) Battery

Parameter: Efficiency (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 109	72%			Goal. 1980 to 1981. Experimental battery for utility peak shaving. For installation at BEST facility. DC to DC. 54.8 kWh battery.
	76.8%			Goal. 1984 to 1985. Experimental "FC" battery for utility peak shaving. DC to DC. 57.9 kWh battery.
	79.4%			Goal. 1989 to 1990. Experimental "FC + 5" battery for utility peak shaving. DC to DC. 66.0 kWh.
	70.0%			Goal. 1989 to 1990. Experimental "FC + 5" battery for utility peak shaving. AC to AC. 66.0 kWh.
B. 10	65%			Expected efficiency. Electric vehicle service. Including parasitics.
B. 114	65%			Assumed 1990 EV battery efficiency.
	78%			Assumed 2000 EV battery efficiency.

DATA SHEET

Energy Conversion System: Zn/Cl_2 - Battery

Parameter: Volume/Size and Footprint

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 1	1.12 X 1.12 X 1.52m		52kWh	Per module
	55 X 43 X 5.5m (180 X 140 X 18ft)		100MWh plant	
B. 7	$0.38m^3$		51.4kWh	EV
B. 52	$0.38m^3$		50.4kWh	Design study EV
B. 109	$\frac{8\ kWh}{ft^2}$ 20 ft height		20000 kW	Design goal. 100 MWh utility peak shaving plant. AC to AC basis.
	$7.5\ kWh/ft^2$		20000 kW	Mark 4 design for 100 MWh utility peak shaving plant. DC to DC basis.
	$7.5\ kWh/ft^2$		20000 kW	Mark 4 design for 100 MWh utility peak shaving plant. AC to AC basis.

DATA SHEET

Energy Conversion System: Zn/Cl_2 - Battery

Parameter: Weight (or specific energy)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	500kg (101Wh/kg)		51.4kWh	EV
B. 23	99Wh/kg		50.4kWh	
B. 52	499.4kg (101Wh/kg)		50.4kWh	Design study
B. 106	30 Wh/lb			1980 goal. Electric vehicle service. Specific energy. 3 hour discharge rate to 80% DOD.
		22.7 W/lb		Experimental electric vehicle battery. Specific energy.
	31.8 W/lb			1980 DOE goal. Electric vehicle battery. Specific power. 30 sec. at 50% DOD.
		31.8 W/lb		Experimental electric vehicle battery. Specific power.
B. 10	45.5 Wh/lb			Electric vehicle battery. Optimistic projection. 3 hr discharge rate 1980 to 1985.

Energy Conversion System: Zn/Cl_2 (Zinc/Chlorine) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 10	40.9 Wh/lb			Probable projection 1980-1985.
	50.9 Wh/lb			Optimistic projection 1985-1990.
	44.5 Wh/lb			Probable projection 1985-1990.
	54.5 Wh/lb			Optimistic projection 1990-2000.
	47.7 Wh/lb			Probable projection 1990-2000.
	47.7 Wh/lb			Electric vehicle battery. Optimistic projection. 5 hr discharge rate. 1980-1985.
	43.2 Wh/lb			Probable projection 1980-1985.
	53.6 Wh/lb			Optimistic projection 1985-1990.
	47.3 Wh/lb			Probable projection 1985-1990.
	59.1 Wh/lb			Optimistic projection 1990-2000.
	50.5 Wh/lb			Probable projection 1990-2000.
	54.5 W/lb			Electric vehicle battery. To 80% DOD. Optimistic projection 1980-1985.
	43.2 W/lb			Probable projection 1980-1985.
	61.4 W/lb			Optimistic projection 1985-1990.
	52.3 W/lb			Probable projection 1985-1990.
	68.2 W/lb			Optimistic projection 1990-2000.
	54.5 W/lb			Probable projection 1990-2000.
B. 114	40.9 Wh/lb			Goal. 1978 EV battery module. To 80% DOD.
	54.5 Wh/lb			Goal. 1980 EV battery module
	54.5 to 68.2 Wh/lb			Goal. 1983 EV battery module for vehicle demonstration.

Energy Conversion System: Zn/Cl_2 (Zinc/Chlorine) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 114	68.2 Wh/lb			Assumed 1990 EV battery specific energy.
	81.8 Wh/lb			Assumed 2000 EV battery specific energy.
	22.7 W/lb			Goal. 1978 EV battery module. Sustained specific power. 3 to 5 hour rate.
	36.4 W/lb			Goal. 1980 EV battery module.
	45.5 W/lb			Goal. 1983 EV battery module for vehicle demonstration.
	45.5 W/lb			Assumed 1990 EV battery sustained specific power.
	54.5 W/lb			Assumed 2000 EV battery sustained specific power.
	54.5 W/lb			Goal. 1978 EV battery module. PK specific power. 15 to 20 sec. at 50% DOD.
	68.2 W/lb			Goal. 1980 EV battery module.
	68.2 W/lb			Goal. 1983 EV battery module for vehicle demonstration.
	68.2 W/lb			Assumed peak specific power. 1990 EV battery.
	81.8 W/lb			Assumed peak specific power. 2000 EV battery.

DATA SHEET

Energy Conversion System: Zn/Cl_2 - Battery

Parameter: Charge and Discharge Time

Energy Conversion System Reference Allocated Reference Number	Parameter Value Study, Goal or Target	Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 7	8 hour charge 4 hour discharge		4MWh	
B. 23	1¼ hour discharge		50kWh	EV
B. 52	8 hour charge 4 hour discharge		50.4kWh	Design study EV
B. 109	5 hour		20000 kW	Discharge time. 100 MWh utility peak shaving battery.
	5-7 hour		20000 kW	Charge time
B. 10	3-5 hour			Discharge time. Electric vehicle service. To 80% DOD.
B. 114	3-5 hour			Discharge time. EV battery. To 80% DOD.

DATA SHEET

Energy Conversion System: Zn/Cl_2- Battery

Parameter: O & M Cost (1980 dollars)

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 1	$0.010-0.019/kWh		4MWh	

DATA SHEET

Energy Conversion System: Zn/Cl_2 - Battery

Parameter: Acquisition Cost

Energy Conversion System Reference — Allocated Reference Number	Parameter Value — Study, Goal or Target	Parameter Value — Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 1	$100/kWh +175/kW auxiliary		4MWh	
B. 7	$35-40/kWh		4MWh	Battery alone Load levelling
	$40-45/kWh		60kWh	Battery alone EV
B. 23	$36-48/kWh		50kWh	EV
	$30/kWh +90/kWh		4MWh	Battery only Balance of plant Load levelling
B. 23	$38.50/kWh		50.4kWh	EV
	$33.50/kWh		58kWh	Peak shave module
B. 52	$41/kWh		50.4kWh	FOB selling price EV
B. 109	$33/kWh plus $116/kW		20000 kW	Goal. Installed cost. 100 MWH utility peak shaving plant.

Energy Conversion System: Zn/Cl_2 (Zinc/Chlorine) Battery

Parameter: Acquisition Cost (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 109	\$35/kWh plus \$113/kW		20000 kW	Estimated installed cost. 25000, 66 kWh modules/yr production. 100 MWh utility peak shaving plant.
	\$57.6/kWh		20000 kW	Estimated installed cost per kWh at \$35/kWh and \$113/kW 100 MWh utility peak shaving plant.
	\$42.8/kWh		20000 kW	Alternative estimated installed cost of 100 MWh utility peak shaving plant.
B. 114	\$1270/kWh			Goal. 1978 EV battery module.
	\$318/kWh			Goal. 1980 EV battery module.
	\$64/kWh			Goal. 1983 EV battery module for vehicle demonstration.
	\$64/kWh			Assumed 1990 EV battery cost.
	\$51/kWh			Assumed 2000 EV battery cost.

DATA SHEET

Energy Conversion System: Zn/Cl_2 - Battery

Parameter: Life-Time (cycle and/or calendar)

Energy Conversion System Reference — Allocated Reference Number	Parameter Value — Study, Goal or Target	Parameter Value — Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 1	2500 cycles	1250 cycles	1.7 kWh	Development stage
	10 years		4MWh	
B. 7	1000 cycles 10 years		51.4 kWh	EV
B. 23	>1000 cycles		50.4 kWh	EV
B. 23	>2000 cycles 10 years		Load levelling size	
B. 106	50 cycles			1980 DOE goal electric vehicle service.
		15 cycles		Experimental electric vehicle battery. Test continuing.
B. 109	2000 to 2500 cycles/10 yrs.		20,000	Utility peak shaving goal. 100 MWh capacity.
	500 cycles			1.7 kWh prototype
	100 cycles			1.0 kWh prototype
B. 10	5 years			Expected lifetime. Electric vehicle service.

Energy Conversion System: Zn/Cl_2 (Zinc/Chlorine) Battery

Parameter: Lifetime (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 114	500 cycles			Goal. 1978 EV battery module.
	1000 cycles			Goal. 1980 EV battery module.
	1000 cycles			Goal. 1983 EV battery for vehicle demonstration.
	1000 cycles			Assumed 1990 EV battery lifetime.
	1200 cycles			Assumed 2000 EV battery lifetime.

DATA SHEET

Energy Conversion System: Ni/Fe - Battery

Parameter: Efficiency

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 7	Projected 60-70%	55-70%		
B. 23	>60%	50%	25 kWh	(Westinghouse EV battery R&D)
B. 86	>60%	>55%	25 kWh	at 3 hour rate
B. 95		55%		Demonstrated efficiency as of 1977. Electric vehicle service. 80% DOD.
	60%			At 1/3 capacity per hour rate. Experimental status. 1980 contract goal.
B. 96		70%		Experimental electric vehicle battery.
B. 106		66%		Experimental Eagle-Picher electric vehicle battery.
B. 110		50 to 60%		Typical. Stationary application.
B. 114	70%			Goal. EV battery. 1977 through 1981.
	70%			Assumed. EV battery. 1985.

DATA SHEET

Energy Conversion System: Ni/Fe - Battery

Parameter: Volume/Size & Footprint

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
	Projected	Current		
B. 7	110 Wh/dm^3	85 Wh/dm^3		
B. 23	Target 100 Wh/dm^3	96 Wh/dm^3		Westinghouse EV R&D
B. 86	Target 135 Wh/dm^3	100 Wh/dm^3		Westinghouse EV R&D

DATA SHEET

Energy Conversion System: Ni/Fe - Battery

Parameter: Weight (or specific energy)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
	Projected			
B. 3	60 Wh/kg	44 Wh/kg		
B. 7	60 Wh/kg	44 Wh/kg		
B. 23	Target 60 Wh/kg	50 Wh/kg	25 kWh	Westinghouse EV R&D
B. 86	60 Wh/kg	44 Wh/kg		
B. 114	20 Wh/lb			1977 goal. EV battery. 100% DOD.
	22.7 Wh/lb			1979 goal
	27.3 Wh/lb			1981 goal
	27.3 Wh/lb			Assumed 1985 specific energy.
	9.1 W/lb			1977 goal. EV battery. Sustained specific power. 3 to 5 hr. rate.
	18.2 W/lb			1979 goal
	22.7 W/lb			1981 goal
	22.7 W/lb			Assumed 1985 specific power. Sustained.

Energy Conversion System: Ni/Fe (Nickel/Iron) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 10	26.8 Wh/lb			5 hr. discharge rate.
	34.1 Wh/lb			Probable projection 1980 to 1985.
	29.1 Wh/lb			Optimistic projection 1985 to 1990.
	38.6 Wh/lb			Probable projection 1985 to 1990.
	31.8 Wh/lb			Optimistic projection 1990 to 2000.
	59.1 W/lb			Probable projection 1990 to 2000.
	46.4 W/lb			Optimistic projection. 1980 to 1985. 80% DOD.
	65 W/lb			Probable projection 1980 to 1985.
	50.9 W/lb			Optimistic projection 1985 to 1990.
	71.4 W/lb			Probable projection 1985 to 1990.
	59.1 W/lb			Optimistic projection 1990 to 2000.
B. 95		20 Wh/lb		Demonstrated specific energy as of 1977. Electric vehicle service. 80% DOD. Experimental status.
	24 Wh/lb			1979 goal
	27.3 Wh/lb			1980 contract goal
		27.3 Wh/lb		Demonstrated cell specific energy.
		24 Wh/lb		Demonstrated 6-cell module specific energy.

Energy Conversion System: Ni/Fe (Nickel/Iron) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 105		36.4 W/lb		Experimental 280 A-h battery. Specific power at 80% DOD.
		50 W/lb		Experimental 220 A-h battery. Specific power at 50% DOD.
		36.4 W/lb		Experimental 220 A-h battery. Specific power at 80% DOD.

Energy Conversion System: Ni/Fe (Nickel/Iron) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 114	59.1 W/lb			1977 goal. EV battery. Peak specific power. 15 to 20 sec. at 50% DOD.
	59.1 W/lb			1979 goal
	90.9 W/lb			1981 goal
	90.9 W/lb			Assumed 1985 peak specific power.
B. 106	24.5 Wh/lb			1980 DOE goal. Specific energy at 3 hr. discharge rate. Electric vehicle service.
		21.8 Wh/#		Specific energy. Experiment of electric vehicle battery.
	50 W/lb			1980 DOE goal. Specific power at 30 sec. at 50% DOD. Electric vehicle service.
		46.8 W/#		Experimental electric vehicle battery. Specific power.
B. 10	27.3 Wh/lb			All in electric vehicle service. Optimistic projection. 1980 to 1985. 3 hr discharge rate.
	25 Wh/lb			Probable projection. 1980 to 1985.
	31.8 W/lb			Optimistic projection 1985 to 1990.
	27.3 Wh/lb			Probable projection 1985 to 1990.
	36.4 Wh/lb			Optimistic projection 1990 to 2000.
	29.5 Wh/lb			Probable projection 1990 to 2000.
	29.1 Wh/lb			Optimistic projection. 1980 to 1985.

Energy Conversion System: Ni/Fe (Nickel/Iron) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 96		21.8 Wh/lb		Experimental specific energy. Battery module. Electric vehicle service.
	27.3 Wh/lb			Goal. Specific energy.
B. 103	18.2 to 29.5 Wh/lb			Projected 1985. Specific energy. USSR electric vehicle service.
B. 104	21.8 Wh/lb			1979 DOE goal. Specific energy. Electric vehicle service.
	24.5 Wh/lb			1980 DOE goal
	26.4 Wh/lb			1982 DOE goal
	27.3 Wh/lb			1984 DOE goal
	45.5 W/lb			1979 DOE goal. Specific power. Electric vehicle service. 20 sec. at 50% DOD.
	50 W/lb			1980 DOE goal
	54.5 W/lb			1982 DOE goal
	54.5 W/lb			1984 DOE goal
	31.8 W/lb			1979 DOE goal. Specific power. Electric vehicle service. 1/2 hour rate.
	36.4 W/lb			1980 DOE goal
	40.9 W/lb			1982 DOE goal
	43.2 W/lb			1984 DOE goal
B. 105		50 W/lb		Experimental 280 A-h electric vehicle battery. Peak specific power for 30 sec. at 50% DOD.

DATA SHEET

Energy Conversion System: Ni/Fe - Battery

Parameter: Charge & Discharge Time

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
	Projected	Current		
B. 7	1.2 h	2.2 h		Discharge time
B. 23	2-4 discharge 6 h charge		25 kWh	Westinghouse R&D
B. 86	2-4 discharge 4-8 charge	2 h 2 h	25 kWh	
B. 95	4-8 hours			Charge time. Electric vehicle service. 1980 contract goal. Experimental status.
	6 hours			Charge time. 1979 goal.
		3 hours		Charge time. Demonstrated 1977.
	2-4 hours			Discharge time. 1980 contract goal. 80% DOD. At 1/3 capacity per hour rate.
	3 hours			Discharge time. 1979 goal.
		2 hours		Discharge time. Demonstrated 1977.

Energy Conversion System: Ni/Fe (Nickel/Iron) Battery

Parameter: Charge and Discharge Times (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 96	6 hours			Goal. Charge time. Electric vehicle service.
	3 hours			Goal. Discharge time. 1/3 capacity per hour rate.
B. 106	3 hours			Discharge time. Electric vehicle battery. To 80% DOD.
B. 10	3 to 5 hours			Discharge time. Electric vehicle service. To 80% DOD.
B. 114	3 to 5 hours			Discharge time. EV battery. To 80% DOD.

DATA SHEET

Energy Conversion System: Ni/Fe - Battery

Parameter: Acquisition Cost

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 3	-----	$1300/kWh		
B. 7	$60-70/kWh	"Several hundred dollars/kWh"		
B. 23	$75-110/kWh		25 kWh	Westinghouse R&D (1979 goal)
B. 86	$76/kWh	$152/kWh	25 kWh	
B. 95	$60/kWh			1980 contract goal. Electric vehicle service. Experimental status.
	$120/kWh			1979 projected price based on pilot manufacturing.
B. 104	$1305/kWh			1979 DOE goal. Electric vehicle service. 50 batt/yr/contractor.
	$544/kWh			1980 DOE goal. 100 batt/yr/contractor.
	$381/kWh			1982 DOE goal-300 batt/yr/contractor.
	$326/kWh			1984 DOE goal. 500 batt/yr/contractor.

Energy Conversion System: Ni/Fe (Nickel-Iron) Battery

Parameter: Acquisition Cost (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 114	$152/kWh			1977 goal. EV battery. Greater than 10^4 battery per year production.
	$89 to $102/kWh			1979 goal
	$64 to $76/kWh			1981 goal
	$64 to $76/kWh			Assumed 1985 EV battery cost in production greater than 10^4 battery/yr.

DATA SHEET

Energy Conversion System: Ni/Fe - Battery

Parameter: Lifetime (cycle and/or calendar)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
	Projected			
B. 3	>1000 cycles	>800 cycles		
B. 7	2000* cycles	1500* cycles		80% DOD (depth of discharge)
B. 23	2000 cycles	1600-1800 cycles	25 kWh	60% DOD (Westinghouse R&D)
B. 86	2000 cycles	1500 cycles	25 kWh	
B. 95	800 cycles			1979 goal. 80% DOD. Electric vehicle service. Experimental status.
		400 cycles		Demonstrated lifetime. 80% DOD. Cell only.
		300 cycles		Demonstrated lifetime. 80% DOD. 6 cell module.
B. 96	1500 cycles			Goal. Electric vehicle service.
B. 104	800 cycles			1979 DOE goal. Electric vehicle service.
	1500 cycles			1980 DOE goal.
	1800 cycles			1982 DOE goal.
	2000 cycles			1984 DOE goal.

Energy Conversion System: Ni/Fe (Nickel-Iron) Battery

Parameter: Lifetime (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 106	300 cycles			1980 DOE goal. Electric vehicle service. Rated to 80% DOD with end of life at 75% retained capacity.
		360 cycles		Experimental electric vehicle battery. Tests continuing
B. 110	2000 cycles			Typical. Stationary duty. To 80% DOD.
B. 114	1500 cycles			1977 goal. EV battery. To 80% DOD.
	1500 cycles			1979 goal
	1500 cycles			1981 goal
	2000 cycles			Assumed 1985 EV battery lifetime.

DATA SHEET

Energy Conversion System: Lead Acid - Battery

Parameter: Efficiency (overall)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	>60%	65-70%	Golf cart size	Motive power
B. 23	60%		20-30 kWh	(projected ISOA) EV battery Globe Union)
B. 23	60%		30-40 kWh	(projected, advanced, EV battery Globe Union)
B. 23	80%		10 MWh	Design study Gould
	83%		10 MWh	C & D
	82%		10 MWh	ESB
B. 27		83%	90kWh	(Photovoltaic) (ISOA=Improved State of the Art)
B. 90	75%			Electric vehicles
B. 91		64%		High rate taper direct current charge. Electric vehicle battery. 63% DOD. 300 AMP-hr. battery. 0.77 hr charge.
		80%		Contant current charge. 300A-L battery. 64% DOD 1.33 hr charge
		71%		Postive pulse charge. 300 A-L. battery 64% DOD. 1.35 hr charge

Energy Conversion System: Lead Acid-Battery

Parameter: Efficiency (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 90	75%			Electric vehicles
B. 91		64%		High rate taper direct current charge. Electric vehicle battery. 63% DOD. 300 Amp-hr battery. 0.77 hr charge.
		80%		Constant current charge. 300 A-h battery. 64% DOD. 1.33 hr charge
		71%		Positive pulse charge. 300 A-h battery. 64% DOD.1.28 hr charge.
		66%		Romanov pulse charge. 300 A-h battery. 64% DOD.1.35 hr charge.
		61%		McCulloch pulse charge. 300 A-h battery. 62% DOD. 1.28 hr charge
B. 92	60%			Improved state of the art electric vehicl battery. 3 hr discharge rate and 8 hr charge rate. 80% DOD.
B. 110		75%		Typical. Stationary application.
B. 114	65%			1977 goal. EV battery.
	70%			1979 goal. EV battery.
	70%			1981 goal. EV battery.
	70%			Assumed 1985 EV battery efficiency.

DATA SHEET

Energy Conversion System: Lead Acid - Battery

Parameter: Volume/Size and Footprint

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
		78-81 Wh/dm^3		SLI
		60-120 Wh/dm^3		Motive power
		35-50 Wh/dm^3		Stationary and Plante
B. 7		87 Wh/dm^3		Sealed
		79-87 Wh/dm^3		Photovoltaic (low rate)
	Projected 90 Wh/dm	60 Wh/dm^3	Golf cart size	Motive Power ISOA
	0.295X0.406X2.64m		20-30 kWh	Projected ISOA
			30-40 kWh	Projected Advanced
			10MWh	Design Study
	2.44X0.91X1.22m		(64,000*Ah)	Gould
B. 23			(10,000*Ah)	C & D
	0.55X0.55X1.43m		(10,000*Ah)	ESB

*Module or cell size

DATA SHEET

Energy Conversion System: Lead Acid-Battery

Parameter: Weight (or specific energy)

Energy Conversion System Reference Allocated Reference Number	Parameter Value Study, Goal or Target	Parameter Value Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 3	Projected 50 Wh/kg	30 Wh/kg		
		45-48 Wh/kg		SLI
		18-33 Wh/kg		Motive Power
		17-20 Wh/kg		Stationary
B. 7		33 Wh/kg		Sealed
		25-42 Wh/kg		Photovoltaic (Low rate)
	50 Wh/kg	25-30 Wh/kg	Golf cart size	Projected ISOA
	40 Wh/kg		20-30 kWh	Projected ISOA
	60 Wh/kg		30-40 kWh	Projected Advanced
B. 23				
			10 MWh	Design study
	5508 kg (22.7 Wh/kg)		(64,000*Ah)	Gould
	1201 kg (16.5 Wh/kg)		(10,000*Ah)	C & D
	1020 kg (19.6 Wh/kg)		(10,000*Ah)	ESB

* Module or cell size

Energy Conversion System: Lead Acid-Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 89		1056 lb.		Flat 900 T. Experimental Electric Van.
		2024 lb.		IVECO-UNIC electric van.
B. 90	15 Wh/lb			Electric vehicle.
B. 92	18.2 Wh/lb*			Improved state-of-the-art electric vehicle batter. *Specific energy at 3 hr discharge, 8 hr. charge. **Specific power at 15 SCC discharge rate. 80% DOD.
B. 93		70 W/lb		Specific power. Globe-Union standard golf cart, deep discharge battery. Instantenous.
		81.7 W/lb		Specific power. Improved golf cart battery. GC 2-19.
		81.8 W/lb		Specific power. Electtic vehicle experimental battery. EV 4-19.
		112 W/lb		Specific power. Experminetal electric vehicle battery. EV 2-13.
		11.6 Wh/lb		Specific energy. Globe-Union standard golf cart, deep discharge battery. At 1/3 of capacity per hour discharge rate.
		13.3 Wh/lb		Specific energy. Improved golf cart battery. GC 2-19.
		15.0 Wh/lb		Specific energy. Experimental electric vehicle battery. EV 4-19.
		17.0 Wh/lb		Specific energy. Experimental electric vehicle battery. EV 2-13
		67 W/lb		Specific power. Experimental Globe-Union imporved state-of-the-art electric vehicle battery.
		19.3 Wh/lb		Specific energy. Experimental. Improved state-of-the-art electric vehicle battery.

Energy Conversion System: Lead-Acid Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 99	14 Wh/lb			Deep discharge battery for electric vehicle. Accessory service. Specific energy.
B. 101	20.9 Wh/lb			Electric vehicle service. Specific energy. Specific power at peak.
	45.5 W/lb			Electric vehicle service. Specific energy. Specific power at peak.
B. 104	15.5 Wh/lb			1979 DOE goal. Specific energy. Electric vehicle service.
	19.1 Wh/lb			1980 DOE goal
	22.7 Wh/lb			1982 DOE goal
	22.7 Wh/lb			1984 DOE goal
	36.4 W/lb			1979 DOE goal. Specific power. Electric vehicel service. 20 seconds at 50% DOD.
	40.9 W/lb			1980 DOE goal
	43.2 W/lb			1982 DOE goal
	45.5 W/lb			1984 DOE goal
	15.9 W/lb			1979 DOE goal. Specific power. Electric vehicle service. 1/2 hour rate.
	18.2 W/lb			1980 DOE goal
	20.5 W/lb			1982 DOE goal
	22.7 W/lb			1984 DOE goal
B. 106	19.1 Wh/lb			1980 DOE electric vehicle battery goal. 3 hr discharge rate to 80% DOD. Specific energy.
		18.6 Wh/lb		Experimental electric vehicle battery . Specific energy.

Energy Conversion System: Lead-Acid Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 10	45.5 W/lb			Optimistic projection 1985 to 1990.
	43.2 W/lb			Probable projection 1985 to 1990.
	50 W/lb			Optimistic projection 1990 to 2000.
	44.5 W/lb			Probable proejction 1990 to 2000.
B. 114	13.6 Wh/lb			1977 goal. EV battery. To 100% DOD. 3 to 5 hr. rate.
	18.2 Wh/lb			1979 goal
	22.7 Wh/lb			1981 goal
	22.7 Wh/lb			Assumed 1985 EV battery. Specific energy.
	6.8 W/lb			1977 goal. EV battery. Sustained specific power. 3 to 5 hr. rate.
	9.1 W/lb			1979 goal
	11.4 W/lb			1981 goal
	11.4 W/lb			Assumed 1985 EV battery. Sustained specific power. 3 to 5 hr. rate.
	22.7 W/lb			1977 goal. EV battery peak. Specific power. 15 to 20 sec. rate. at 50% DOD.
	45.5 W/lb			1979 goal
	68.2 W/lb			1981 goal
	68.2 W/lb			Assumed 1985 EV battery peak. Specific power. 15 to 20 sec. rate.

Energy Conversion System:

Parameter:

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 106	50.5 W/lb			1980 DOE electric vehicle goal. Specific power. 30 sec. discharge at 50% DOD.
		47.7 W/lb		Experimental electric vehicle battery. Specific power.
B. 10	21.4 Wh/lb			Electric vehicle service. Optimistic projection. 1980 to 1985. 3 hr. rate.
	19.1 Wh/lb			Probable projection. 1980 to 1985.
	23.6 Wh/lb			Optimistic projection 1985 to 1990.
	20.9 Wh/lb			Probable projection 1985 to 1990.
	25.9 Wh/lb			Optimistic projection 1990 to 2000.
	22.3 Wh/lb			Probable projection 1990 to 2000.
	24.5 Wh/lb			Optimistic projection 1980 to 1985. 5 hr. rate.
	21.8 Wh/lb			Probable projection 1980 to 1985.
	26.8 Wh/lb			Optimistic projection 1985 to 1990.
	24.1 Wh/lb			Probable projection 1985 to 1990.
	29.5 Wh/lb			Optimistic projection 1990 to 2000.
	25.5 Wh/lb			Probable projection 1990 to 2000.
	34.1 W/lb			Optimistic projection. 1980 to 1985. At 80% DOD.
	30 W/lb			Probable projection 1980 to 1985.

DATA SHEET

Energy Conversion System: Lead Acid - Battery

Parameter: Charge and Discharge Time (*Nominal rate)

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
		20 hours*		SLI
		6 hours*		Motive power
		8 hours*		Stationary & Plante
		20 hours*		Sealed
B. 7		500 hours*		Photovoltaic Low rate Pb-Ca
		600 hours*		Photovoltaic Low rate (pure Pb)
		8 hours*		Medium rate, photovoltaic
B. 7	2 hours	Discharge	Golf cart size	Projected motive power
B. 23	4-8 hours	Charge	20-30 kWh	Projected ISOA
	2-4 hours	Dishcarge	30-40 kWh	Projected Advanced
	Load levelling Duty		10 MWh	Design Study Gould C & D ESB
B. 91		0.77 hr		Charge time. Electric vehicle battery. 300 A-h battery. High rate direct current charge. 63% DOD.
		1.33 hr		Charge time. 300 A-h battery. Constant current charge. 64% DOD.

Energy Conversion System: Lead Acid-Battery

Parameter:Charge/Discharge Time (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
		1.28 hrs.		Charge time. 300 A-h battery. Positive pulse charge. 64% DOD.
		1.35 hrs.		Charge time. 300 A-h battery. Romanov pulse charge. 64% DOD.
		1.28 hrs.		Charge time. 300 A-h battery. McColluch pulse charge. 61% DOD.
B. 92	3 hr discharge/ 8 hr charge			Improved state-of-the-art electric vehicle battery. 80% DOD.
B. 106	3 hrs.			Discharge time. Electric vehicle battery. To 80% DOD
B. 112	5 hrs.			Discharge time. Utility load leveling service.
B. 113	3 to 5 hrs.			Discharge time. Electric vehicle service. 80% DOD.
B. 114	3 to 5 hrs.			Discharge time. EV battery. To 80% DOD.
B. 111	12 hrs.			Discharge time. Lead Calcium battery.

Energy Conversion System: Lead-Acid Battery

Parameter: O&M

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 90	(List price x 4 x 10^{-4})¢/mile			Maintenance costs. Battery. Electric vehicle.

DATA SHEET

Energy Conversion System: Lead Acid -Battery

Parameter: Aquisition Cost $/kWh

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 3	Projected 93.00	140.00		
		70.00		SLI Pb-Sb
		70-77.00		SLI Pb-Ca
		142-162		Diesel Starting
		112-130		Motive Pb-Sb
		150-200**		Power Pb-Ca
B. 7*		112-130		Stationary Pb-Sb
		122-130		Stationary Pb-Ca
		365		Plante (pure Pb)
		135-175**		Photovoltaic Low rate Pb-Ca
		98		Photovoltaic Low rate (pure Pb)
		165-225**		Photovoltaic Med. rate Pb-Ca
		375		Sealed Pb-Ca

*All prices are based on $1.32/kg of lead (mid 1979)
**Includes battery trays and interconnections

	60.00		20-30 kWh	(projected) ISOA
	48.00		30-40 kWh	(projected) Advanced
			10 MWh	Design study
B. 23	59.00 (30.00 replacement)			Gould
	89.00 (71.00 replacement)			C & D
	92-100. (71-78 replacement)			ESB

Energy Conversion System: Lead Acid-Battery

Parameter: Acquisition Cost (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 90	$71/kWh			Electric vehicle. Cost to vehicle manufacturer.
	$1.08/lb			Manufacturing cost
B. 92	$50/kWh			Improved state-of-the-art electric vehicel battery. 80% DOD.
B. 101	$42/kWh			Electric vehicle service.
B. 104	$109/kWh			1979 EOE cost gaol at 200 batteries/year per contractor (1980 $). Electric vehicle service.
	$109/kWh			1980 DOE cost goal at 400 batt./yr/contractor.
	$87/kWh			1982 DOE cost goal at 1100 batt/yr./contractor.
	$65/kWh			1984 DOE cost goal at 2000 batt/yr./contractor.
B. 112	$63.5/kWh			Utility load leveling service.
	$445/kWh			
B. 10	$109/kWh			Improved state-of-the-art battery for electric vehicle service. Expected 1982 cost.
	$57.6/kWh			Improved state-of-the-art battery for electric vehicle service. Eventual cost as development proceeds.
B. 114	$63.5/kWh			1977 goal. EV battery. 10^4 batt/yr.
	$63.5/kWh			1979 goal. EV battery. 10^4 batt/yr.
	$63.5/kWh			1981 goal. EV battery. 10^4 batt/yr.
	$50.8/kWh			Assumed 1985 EV battery installed cost.

DATA SHEET

Energy Conversion System: Lead Acid - Battery

Parameter: Life-time (cycle and/or calendar)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 3	Projected >1000 cycle	700 cycles		
	years	cycles (deep)		
	2-5	150-250		SLI Pb-Sb
	2-5	20-50		SLI Pb-Ca
	5-15	1000-2000		Motive power Pb-Sb
	10-20	750-1500		Motive power Pb-Ca
B. 7				
	15	250-500		Stationary Pb-Sb
	15-24	100-500		Stationary Pb-Ca
	24-30	250-500		Plante (pure Pb)
	10-20	350		Photovoltaic Pb-Ca
	5-15	---		Photovoltaic (pure Pb)
	2-5	100-200		Sealed, Pb-Ca
B. 7	Projected 1000	Current 300-700		ISOA (improved state of the art)
	800 1000		EV size	Projected ISOA -n- Advanced
B. 23	years cycles		10 MWh	Load levelling Design Study
	7 1750		------	Gould
	10 2500		------	C & D
	10 2500		------	ESB (Inco)
B. 40		14-16 yrs. 20-25 yrs.		Standby Pb-56 Standby PB-Ca

Energy Conversion System: Lead-Acid Battery

Parameter: Lifetime (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 89		17360 miles		Flat 900 T experimental electric van.
B. 90	300 cycles			80% DOD, 3 hr rate. Electric vehicle.
B. 92	800 cycles			Improved state-of-the-art. 3 hr discharge.
B. 101	1000 cycles			8 hr charge. Electric vehicle. 80% DOD.
B. 104	300 cycles			1979 DOE goal. Electric vehicle service.
	300 cycles			1980 DOE goal.
	500 cycles			1982 DOE goal.
	750 cycles			1984 DOE goal.
B. 106	400 cycles			1980 DOE goal. Electric vehicle service.
		270 cycles		Experimental electric vehicle battery. Tests continuing.
B. 110		500 cycles		Typical. Stationary applications. To 80% DOD.
B. 112	14 years			Utility load leveling service. 5 hr. discharge time.
B. 10	500-800 cycles			Projected lifetime in electric vehicle service. Year 1981. Improved state-of-the-art battery
	1000 cycles			Goal. Advanced battery. Electric vehicle service.
B. 114	700 cycles			1977 goal. EV battery. To 80% DOD.
	800 cycles			1979 goal.
	1000 cycles			1981 goal.
	1000 cycles			Assumed 1985 lifetime. EV battery. To 80% DOD.
B. 111	Six years			Lead-Calcium battery.

DATA SHEET

Energy Conversion System: Zn/Br_2 -Battery

Parameter: Efficiency

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 7	∿75%			
B. 83	70-76% overall 80-87% voltaic		100MWh (10-20 MW)	Development (Feasibility stage)
	90% cou[illegible]ic		Modular	Design study
B. 100	65 to 70%			Design specification. Electric vehicle service.

DATA SHEET

Energy Conversion System: Zn/Br_2 - Battery

Parameter: Volume/Size and Footprint

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 83	5.0 X 1.8 X 1.5m per module		400kWh per module (100MWh)	Development feasibility stage Design study

DATA SHEET

Energy Conversion System: Zn/Br_2- Battery

Parameter: Weight (or specific energy)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	60Wh/kg			Estimate
B. 100	29.6 to 31.8 Wh/lb			Design specification. Specific energy. Electric vehicle service.
	36.4 to 45.5 W/lb			Design specification. Specific power.

DATA SHEET

Energy Conversion System: Zn/Br_2 - Battery

Parameter: Charge and Discharge Time

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 83	5-10h		100MWh	Development feasibility state Design study

DATA SHEET

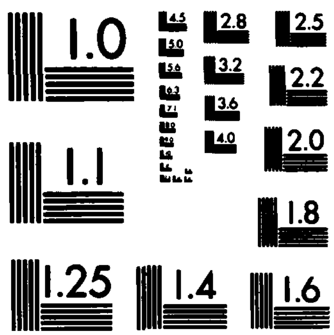
Energy Conversion System: Zn/Br_2 - Battery

Parameter: Acquisition Cost (1980 dollars)

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 7	\$21-42/kWh		----	Estimate
B. 83	\$55-75/kWh		100MWh (modular)	Development feasibility stage Design study
B. 100	\$30 to 40/kWh			Estimated assembly line production. Cost to IEM in large volumes. Electric vehicle service.

AD-A133 514 USAF ADVANCED TERRESTRIAL ENERGY STUDY VOLUME 4 ANALYSIS DATA AND BIBLIOG..(U) INSTITUTE OF GAS TECHNOLOGY CHICAGO ILL E J DANIELS ET AL. APR 83 61045 7/8

UNCLASSIFIED AFWAL-TR-82-2019-VOL-4 F33615-80-C-2041 F/G 10/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

DATA SHEET

Energy Conversion System: Na/S - Battery

Parameter: Efficiency

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	75-90%	60-80%		5h rate
B. 26		76.8% (new) 75.2 (after 2500 cycles)	100 MWh	Study
B. 47		85%		Utilization of active materials

DATA SHEET

Energy Conversion System: Na/S - Battery

Parameter: Volume/Size and Footprint

Energy Conversion System Reference Allocated Reference Number	Parameter Value Study, Goal or Target	Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 26	Height 0.68m-0.64m*		50 kWh module	100 MWh Design study
	Length 1.60m-1.60m*			
	Width 0.42-0.48m*			
	Volume $0.46m^3$-$0.49m^3$*			

* Center sulfur electrode

B. 47	200 Wh/dm^3			Current state of the art

DATA SHEET

Energy Conversion System: Na/S - Battery

Parameter: Weight (or specific energy)

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 3		90 Wh/kg		
B. 82		109 Wh/kg	(208 Wh)	Development single cell
B. 26	506-578 kg*		100 MWh	Design study
	(99-86.5* Wh/kg)		50 kWh per module	
B. 10	47.7 Wh/lb			Utility or electric vehicle battery. 3 hr. discharge rate. 1985 1990. Optimistic projection.
	40.9 Wh/lb			Probable projection 1985 to 1990.
	54.5 Wh/lb			Optimistic projection 1990 to 2000.
	49.1 W/lb			Probable projection 1990 to 2000.
	55.5 Wh/lb			Utility or electric vehicle battery. 5 hr. discharge rate. 1985 to 1990. Optimistic projection.
	47.7 Wh/lb			Probable projection 1985 to 1990.

*sulfur electrode inside B-alumina tube.

Energy Conversion System: Na/S (Sodium/Sulfur) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 10	63.6 Wh/lb			Optimistic projection 1985 to 1990.
	56.8 Wh/lb			Probable projection 1990 to 2000.
	54.5 W/lb			Utility or electric vehicle battery. To 80% DOD. Optimistic projection 1985 to 1990.
	45.5 W/lb			Probable projection 1985-1990.
	63.6 W/lb			Optimistic projection 1990-2000.
	54.5 W/lb			Probable projection 1990-2000.

DATA SHEET

Energy Conversion System: Na/S- Battery

Parameter: Charge and Discharge Time

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
	Projected			
B. 81	1 hour	2 hours min. discharge	EV size	EV battery development
B. 82		5h discharge 7h discharge		
B. 47		2h discharge	EV size	
B. 26	7h charge 10h discharge		100 MWh	Design study
B. 10	3 to 5 hours			Utility or electric vehicle battery. To 80% DOD. Discharge time.

DATA SHEET

Energy Conversion System: Na/S - Battery

Parameter: Acquisition Cost (1980 dollars)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 2	Projected $94-118/kWh			
B. 3	$50/kWh	$2000/kWh		
B. 7	$48/kWh			
B. 23		$100/kWh	Load levelling size	
	$18-26*/kWh		100 MWh	Cell only — Current State Of The Art
B. 26	$35-48*/kWh		100 MWh	Module only
	$49-63*/kWh		100 MWh	Total plant including civil engineering
B. 31	DM 180/kWh (1978)		13.6 MWh	

*sulfur electrode in center

DATA SHEET

Energy Conversion System: Na/S - Battery

Parameter: Life-Time (cycle and/or calendar)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
	Projected			
B. 3	>1000 cycles	200 cycles		
B. 7	2000+	200* 1000**		*(glass capillary) **(B-alumina)
B. 82	2500	700		Single cell Development
B. 26	2500 cycles 10 years		100MWh	Design study
B. 36		10,000		Small cell exp.
B. 10	400 cycles			Routinely achieved in single cells

DATA SHEET

Energy Conversion System: REDOX, Cr/Fe - Battery

Parameter: Efficiency

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	60-70%		Min 150kWh	Development stage
B. 107		81%		Experimental battery
B. 108		70-80%		Experimental battery

DATA SHEET

Energy Conversion System: REDOX, Cr/Fe - Battery

Parameter: Volume/Size and Footprint

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	$0.17m^3$* ($+28 + 28m^3$ for two tanks)		10kW	*cell stack only

DATA SHEET

Energy Conversion System: REDOX, Cr/Fe - Battery

Parameter: Acquisition Cost (1980 dollars)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	$28-30/kWh		10-400kWh	Development stage
B. 23	$72/kWh		500kWh (10kW)	
B. 107	$72.2/kWh		10kW	Solar PV application. 500 hr. rate. Current materials prices. Current manufacturing process. Current stack component costs. As installed.
	$26.1/kWh		10kW	Solar electrical storage. 500kWh capacity. Based on improved processes for chromium chloride production and existing techniques for water electrodialysis unity and fuel cell systems.

DATA SHEET

Energy Conversion System: REDOX, Cr/Fe - Battery

Parameter: Charge and Discharge Time

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	4-5 hours but depends on tank size in addition to discharge and charge rates		400Wh	Development stage
B. 107	50 hr.		10 kW	Solar PV application. Discharge time.

DATA SHEET

Energy Conversion System: REDOX, Cr/Fe - Battery

Parameter: Life-Time (cycle and/or calendar)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	25-30 years		Min 150kWh	Development stage
B. 107	20 years			Very long lived membrane. Inherently simple system.
B. 108		3000 cycles		Experimental battery. Capable of 90% DOD. Lifetime experiment continuing
	25 to 30 years			

DATA SHEET

Energy Conversion System: Li/Al/FeS_x - Battery

Parameter: Efficiency

Energy Conversion System Reference		Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number		Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7		75%	70-80%		Initially decreasing
B. 29 B. 84 B. 85			79.5%-84.3% (initally decreasing)	(EV) size	Development stage

DATA SHEET

Energy Conversion System: Li-Al/FeS_x - Battery

Parameter: Volume/Size and Footprint

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	300Wh/dm^3	99 Wh/dm^3	Load levelling	(cell only)
B. 23	100-300Wh/dm^3 375 Wh/dm^3(long range projection)		EV size	
B. 29	240 (cell only) 100 (battery)		EV size	Mark 1A (1979)

DATA SHEET

Energy Conversion System: Li-Al/FeS_x

Parameter: Weight (or specific energy)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 3	150Wh/kg	100Wh/kg		
B. 23	75-130Wh/kg 155Wh/kg (long range projection)		EV size	
B. 29	80Wh/kg (cell)	40-115Wh/kg	EV size	Mark 1A (1979)
B. 84				
B. 85	60Wh/kg (battery)	--------		

DATA SHEET

Energy Conversion System: Li-Al/FeS_x- Battery

Parameter: Charge and Discharge Time

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 7	5-10h charge 3-14h discharge			Development stage
B. 29	4h	4-5h		
B. 84	4h	4-5h		
B. 85	4h	4-5h		

DATA SHEET

Energy Conversion System: Li-Al/FeS_x - Battery

Parameter: Acquisition Cost

Energy Conversion System Reference: Allocated Reference Number	Parameter Value: Study, Goal or Target	Parameter Value: Operating Plant or Experimental Results	Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art or Comments
B. 3	\$50/kWh	>\$2000/kWh		
	\$30-35/kWh		Load levelling size	Battery only
B. 7	\$50-60/kWh		Load levelling size	Complete plant
	\$40-50/kWh		EV size	EV battery
B. 23	\$35-45/kWh		Load levelling size	Including balance of plant
B. 29	\$44.60/kWh (charged) \$26.10/kWh (uncharged)		Stationary Energy storage	Cells only Based on current state of art
B. 84	\$57.60/kWh (charged) \$37.70/kWh (uncharged)		EV (FeS)	Based on current state of art
B. 85	\$59.80/kWh (charged) \$35.90/kWh (uncharged)		EV (FeS_2)	Based on current state of art

DATA SHEET

Energy Conversion System: Li-Al/FeS_x - Battery

Parameter: Life-Time (cycle and/or calendar)

Energy Conversion System Reference	Parameter Value		Plant or Experiment Size, kWh	Assumptions of Advanced State of the Art
Allocated Reference Number	Study, Goal or Target	Operating Plant or Experimental Results		or Comments
B. 3	>1000 cyles	250 cycles		
	>1000 cycles			EV
B. 7		300 cycles		
	>3000 cycles			Load levelling
	400-1000 cycles			EV
	1000 cycles			EV (Long range)
B. 23	3000 cycles			Load levelling
B. 29 B. 84 B. 85	1979 Goal 200 cycles	180-336 cycles		Development stage

Energy Conversion System: Ni/Zn (Nickel/Zinc) Battery

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 91		52%		Electric vehicle battery. High rate taper direct current charge. 200 AMP-hr battery. 71% DOD. 0.88 hr charge.
B. 92	70%			Electric vehicle battery. 3 hr discharge and 8 hr charge. 80% DOD.
B. 97	60%			Goal. Electric vehicle service. Vibrating negative electrode.
B. 110	75%			Typical. Stationary applications. 80% DOD.
B. 114	60%			1977 goal. EV battery.

Energy Conversion System: Ni/Zn (Nickel/Zinc) Battery

Parameter: Weight

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 92	36.4 Wh/lb*			Electric vehicle battery. *Specific energy at 3 hr discharge and 8 hr charge. 80% DOD.
	68.2 W/lb**			**Specific power at 15 sec. discharge rate.
B. 97	31.8 $\frac{Wh}{lb}$			Goal. Electric vehicle service. 1/3 capacity per hour discharge. 100% DOD capacity basis. Specific energy. Vibrating negative electrode.
	56.8 W/lb			Goal. At 80% DOD condition. Five sec. duration. Specific power.
	20.5 W/lb			Goal. Sustained. Specific power for 20 minutes at 50% DOD at V_3 capacity per hour discharge rate.
B. 101	35 Wh/lb			Electric vehicle service. Specific energy.
	63.6 W/lb			Specific power at peak output
B. 102		18.2 to 27.3 Wh/lb		Electric vehicle service. USSR developed. Specific energy. Experimental batteries.
	31.8 to 36.4 Wh/lb			Projected specific energy
B. 103	18.2 to 29.5 Wh/lb			USSR Specific energy 1985 goal. Electric vehicle service.
B. 104	27.3 Wh/lb			1979 DOE goal. Electric vehicle service. Specific energy.

Energy Conversion System: Ni/Zn (Nickel/Zinc) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 104	29.1 Wh/lb			1980 DOE goal
	30.5 Wh/lb			1982 DOE goal
	31.8 Wh/lb			1984 DOE goal
	50 W/lb			1979 DOE goal. Electric vehicle service. Specific power. 20 sec. at 50% DOD.
	63.6 W/lb			1980 through 1984 DOE goal.
	36.4 W/lb			1979 DOE goal. Electric vehicle service. Specific power. 1/2 hour rate.
	36.4 W/lb			1980 DOE goal
	40.9 W/lb			1982 DOE goal
	43.2 W/lb			1984 DOE goal
B. 105		63.6 W/lb		Experimental Gould 225 A-h electric vehicle battery. Specific power at 30 sec. duration. 50% DOD.
		54.5 W/lb		Experimental Gould 225 A-h battery. Specific power. 80% DOD.
		59.1 W/lb		Experimental Gould 400 A-h electric vehicel battery. Specific power. 50% DOD.
		47.7 W/lb		Experimental Gould 400 A-h battery. Specific power. 80% DOD.
B. 106	29.1 Wh/lb			1980 DOE goal. Specific energy at 3 hr discharge rate. Electric vehicle service.
		29.5 Wh/lb		Experimental electric vehicle battery. Specific energy.

Energy Conversion System: Ni/Zn (Nickel/Zinc) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 10	61.4 W/lb			Probable projection 1985-1990.
	79.5 W/lb			Optimistic projection 1990-2000.
	63.6 W/lb			Probable projection 1990-2000.
B. 114	31.8 Wh/lb			1977 goal. EV battery. To 80% DOD.
	31.8 Wh/lb			1979 goal
	40.9 Wh/lb			1981 goal
	40.9 Wh/lb			Assumed 1985. Specific eneryg. EV battery.
	9.1 W/lb			1977 goal. EV battery. Sustained. Specific power. 3 to 5 hr rate.
	18.2 W/lb			1979 goal
	22.7 W/lb			1981 goal
	22.7 W/lb			Assumed 1985. Sustained. EV battery. Specific power.
	59.1 W/lb			1977 goal. EV battery. Peak specific power 15 to 20 sec. at 50% DOD.
	68.2 W/lb			1979 goal
	90.9 W/lb			1981 goal
	90.9 W/lb			Assumed 1985. EV battery peak. Specific power.

Energy Conversion System: Ni/Zn (Nickel/Zinc) Battery

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 106	50 W/lb			1980 DOE goal. Electric vehicle service. Specific power. 30 sec. at 50% DOD.
		59.5 W/lb		Experimental electric vehicle battery. Specific power.
B. 10	34.5 Wh/lb			Electric vehicle battery. 3 hr discharge rate. Optimistic projection 1980 to 1985.
	31.8 Wh/lb			Probable projection 1980 to 1985.
	38.6 Wh/lb			Optimistic projection 1985 to 1990.
	34.5 Wh/lb			Probable projection 1985 to 1990.
	41.8 Wh/lb			Optimistic projection 1990 to 2000.
	36.4 Wh/lb			Probable projection 1990 to 2000.
	36.8 Wh/lb			Electric vehicle battery. 5 hr discharge rate. Optimistic projection. 1980 to 1985
	33.6 Wh/lb			Probable projection. 1980 to 1985.
	41.4 Wh/lb			Optimistic projection 1985-1990.
	36.4 Wh/lb			Probable projection 1985-1990.
	43.6 Wh/lb			Optimistic projection 1990-2000.
	39 Wh/lb			Probable projection 1990-2000.
	63.6 W/lb			Electric vehicle battery. To 80% DOD. Optimistic projection. 1980 to 1985.
	56.8 W/lb			Probable projection 1980-1985.
	72.7 W/lb			Optimistic projection 1985-1990.

Energy Conversion System: Ni/Zn (Nickel/Zinc) Battery

Parameter: Charge and Discharge Time

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 91		0.88 hr		Electric vehicle battery. High rate taper direct current charge. 200 AMP-hr battery. 71% DOD.
B. 92	3 hr discharge/ 8 hr charge			Electric vehicle battery. 80% DOD.
B. 114	3 to 5 hours			Discharge time. EV battery. To 80% DOD.
B. 97	4 to 8 hours			Goal. Charge time. Electric vehicle service. Vibrating negative electrode. Discharge time.
B. 106	3 hours			Discharge time. Electric vehicle service. To 80% DOD.
B. 10	3 to 5 hours			Discharge time. Electric vehicle service. To 80% DOD.

Energy Conversion System: Ni/Zn (Nickel-Zinc) Battery

Parameter: Acquisition Cost

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 92	$75/kWh			Electric vehicle battery. 3 hr discharge and 8 hr charge. 80% DOD.
B. 97	$75/kWh			Goal. Electric vehicle service. 10,000 units per year purchase. Vibrating negative electrode.
B. 101	$64/kWh			Electric vehicle service
B. 104	$598/kWh			1979 DOE goal. Electric vehicle service. 40 batt/yr/contractor.
	$544/kWh			1980 DOE goal. 100 batt/yr/contractor
	$504/kWh			1982 DOE goal. 100 batt/yr/contractor.
	$272/kWh			1984 DOE goal. 500 batt/yr/contractor.
B. 10	$109/kWh			Electric vehicle battery projected price. Low production volume.
	$60 to $71/kWh			Electric vehicle battery. Mass production in automated facilities. Projection.
B. 114	$89 to $102/kWh			1979 goal. EV battery. Production of more than 10^4 battery per year.

Energy Conversion System: Ni/Zn (Nickel/Zinc) Battery

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 92	800 cycles			Electric vehicle battery. 3 hr discharge and 8 hr charge. 80% DOD.
B. 97	1000 cycles			Goal. At 80% DOD. Electric vehicles service. Vibrating negative electrode.
B. 101	500-600 cycles			Electric vehicle service. USSR developed. Projected lifetime.
B. 104	100 cycles			1979 DOE goal. Electric vehicle service.
	200 cycles			1980 DOE goal
	300 cycles			1982 DOE goal
	500 cycles			1984 DOE goal
B. 106	200 cycles			1980 DOE goal. Electric vehicle service. Basis 80% DOD. End of life at 75% retained capacity.
		160 cycles		Achieved test continuing.
B. 110	400 cycles			Typical. Stationary applications.
B. 10		200 to 300 cycles		Electric vehicle battery. 1979 cycle life.
	300 to 500 cycles			Projected 1982 electric vehicle cycle life.
B. 114	200 cycles			1977 goal. EV battery. To 80% DOD
	500 cycles			1979 goal
	700 cycles			1981 goal
	700 cycles			Assumed 1985 lifetime. EV battery.

Energy Conversion System: Ni/Cd (Nickel/Cadmium) Battery

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 110	70%			Typical

Energy Conversion System: Ni/Cd (Nickel/Cadmium) Battery

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 110	2000			Typical. To 80% DOD.

Energy Conversion System: Li/FeS (Lithium/Iron) Battery

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 114	70%			Goal. 1979 EV battery
	75%			Goal. 1980 EV battery
	75%			Goal. 1981 EV battery
	75%			Goal. 1985 EV battery
	75%			Assumed efficiency. 1990 EV battery
	90%			Assumed efficiency. 2000 EV battery

Energy Conversion System: Li/FeS (Lithium/Iron Sulfide)

Parameter: Weight

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 10	54.5 Wh/lb			Electric vehicle battery. 3 hr discharge rate. Optimistic projection 1985 to 1990
	50 Wh/lb			Probable projection 1985-1990
	63.6 Wh/lb			Optimistic projection 1990-2000
	54.5 Wh/lb			Probable projection 1990-2000
	63.6 Wh/lb			Electric vehicle battery. 5 hour discharge rate. Optimistic projection 1985-1990.
	58.2 Wh/lb			Probable projection 1985-1990
	70.5 Wh/lb			Optimistic projection 1990-2000
	63.6 Wh/lb			Probable projection 1990-2000
	56.8 Wh/lb			Electric vehicle battery. Specific power at 80% DOD. Optimistic projection 1985-1990
	52.3 W/lb			Probable projection 1985-1990
	68.2 W/lb			Optimistic projection 1990-2000
	59.1 W/lb			Probable projection 1990-2000
B. 114	59.1 Wh/lb			1977 Experimental EV battery. Cell only. 100% DOD. Argonne National Laboratory.

Energy Conversion System: Li/FeS (Lithium/Iron Sulfide)

Parameter: Weight (Cont.)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 114	34.1 Wh/lb			1977 Experimental EV battery. Cell only. Contractor cell. 100% DOD.
	34.1 Wh/lb			Goal. 1979 EV battery. 100% DOD.
	45.5 Wh/lb			Goal. 1980 EV battery.
	59.1 Wh/lb			Goal. 1981 EV battery.
	65.9 to 72.7 Wh/lb			Goal. 1985 EV battery.
	65.9 Wh/lb			Assumed 1990 EV battery. Specific energy.
	79.5 Wh/lb			Assumed 2000 EV battery. Specific energy.
	34.1 W/lb			Goal 1979 EV battery. Peak specific power. 15 to 20 sec. At 50% DOD.
	54.5 W/lb			Goal. 1980 EV battery.
	72.7 W/lb			Goal. 1981 EV battery.
	90.9 W/lb			Goal. 1985 EV battery.
	90.9 W/lb			Assumed 1990 EV battery peak specific power.
	109.1 W/lb			Assumed 2000 EV battery peak specific power.

Energy Conversion System: Li/FeS (Lithium/Iron Sulfide)

Parameter: Charge and Discharge Time

Energy Conversion System Ref.	Parameter Value: Study	Parameter Value: Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 114	3 to 5 hours			Electric vehicle battery.

Energy Conversion System: Li/FeS (Lithium/Iron Sulfide)

Parameter: Acquisition Cost

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 10	\$65.3/kWh			Estimated mass production cost. EV battery.
	\$64/kWh			Goal 1985 EV battery.
	\$64/kWh			Assumed 1990 EV battery cost.
	\$50.8/kWh			Assumed 2000 EV battery cost.

Energy Conversion System: Li/FeS (Lithium/Iron Sulfide) Battery

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
B. 114	300 cycles			Goal. 1979 EV battery. To 80% DOD.
	500 cycles			Goal. 1980 EV battery.
	700 cycles			Goal. 1981 EV battery.
	1000 cycles			Goal. 1985 EV battery.
	1000 cycles			Assumed lifetime. 1990 EV battery.
	1200 cycles			Assumed lifetime. 2000 EV battery.

BATTERY ENERGY CONVERSION SYSTEMS

Bibliography

B-1

ACCESSION NO.	80R0083629
TITLE (MONO)	DEVELOPMENT OF THE ZINC-CHLORIDE BATTERY FOR UTILITY APPLICATIONS. WORK PERIOD: APRIL 1, 1976-MARCH 31, 1980
CORPORATE AUTH	ENERGY DEVELOPMENT ASSOCIATES, MADISON HEIGHTS, MI (USA)
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AUGMENTATION	CONTAINS GLOSSARY
REPORT NO	EPRI-EM--1417
ABSTRACT	SIGNIFICANT ACCOMPLISHMENTS IN THE RESEARCH AND DEVELOPMENT PROGRAMS DURING PHASE II OF THE ZN/CLSSUB 2S BATTERY DEVELOPMENT PROJECT WERE AS FOLLOWS: DEVELOPMENT OF A DATA BASE ON THE DENSITY, CONDUCTIVITY, VISCOSITY, CHLORINE SOLUBILITY, AND THE ZINC TRANSFERENCE NUMBER FOR ZNCLSSUB 2S-KCL-NACL ELECTROLYTES; DEVELOPMENT OF A MODEL DESCRIBING THE HYDRODYNAMIC PHENOMENA OCCURRING BETWEEN INDIVIDUAL ZINC AND CHLORINE ELECTRODES DURING CHARGE; DEMONSTRATION OF CELL ELECTROCHEMICAL ENERGY EFFICIENCIES OF 74% FOR DELIVERED CAPACITY DENSITIES OF 500 WH/CMSSUP 2S; COMPLETION OF RELIABILITY STUDIES FOR 100-MWH BATTERY PLANTS THAT DISCUSS QUANTITATIVELY PLANT AVAILABILITY AND ELECTRICITY COST IN TERMS OF MODULE-FAILURE RATE; INVENTION OF A MODULE-BYPASS SWITCH CONCEPT THAT ISOLATES A FAILED MODULE IN A SERIES-CONNECTED STRING AND THEREBY AVOIDS STRING OUTAGE; DEVELOPMENT OF A COMPUTER MODEL FOR MODULE OPERATION THAT ALLOWS PREDICTION OF THE EFFECTS OF COMPONENT CHANGES ON MODULE PERFORMANCE; AND ACCUMULATION OF 1250 CYCLES - 50% OF THE TARGET FOR BATTERY-STACK LIFE - ON A 1.7-KWH SYSTEM WITH NEGLIGIBLE PERFORMANCE DEGRADATION. 294 FIGURES, 99 TABLES.
DESCRIPTORS	ELECTROCHEMISTRY: D;ELECTROLYTES;ENERGY EFFICIENCY;EXPERIMENTAL DATA: D;MATHEMATICAL MODELS;OFF-PEAK ENERGY STORAGE: T1;PERFORMANCE: D;POTASSIUM CHLORIDES;RELIABILITY;RESEARCH PROGRAMS: Q2,D;SODIUM CHLORIDES;SWITCHES;ZINC CHLORIDES;ZINC-CHLORINE BATTERIES: Q1,D,M2

B-2

ACCESSION NO.	80R0077166
TITLE (MONO)	DEVELOPMENT OF ADVANCED BATTERIES FOR UTILITY APPLICATION. INTERIM REPORT
EDITOR OR COMP	MITOFF, S.P.
CORPORATE AUTH	GENERAL ELECTRIC CO., SCHENECTADY, NY (USA). ENERGY SYSTEMS PROGRAMS DEPT.
PAGE NO	245
AVAILABILITY	NTIS, PC A11/MF A01.
DATE	FEB 1980
CATEGORIES	EDB-250901
PRIMARY CAT	EDB-250901
AUGMENTATION	100 AH, 100-KWH MODULES
REPORT NO	EPRI-EM--1341
ABSTRACT	THE INTERIM RESULTS OF A PROGRAM TO DEVELOP SODIUM-SULFUR BATTERIES FOR UTILITY LOAD-LEVELING APPLICATIONS ARE PRESENTED. THE REPORTING PERIOD IS OCTOBER 1977 THROUGH MAY 1979. DURING THIS PERIOD A MAJOR SCALE-UP TO THE FIRST FULL-SIZE (615 MM X 49.3 MM OD, 100 AH) CELLS WAS ACCOMPLISHED. SAFETY TESTS DEMONSTRATED THE NEED FOR A SAFETY INSERT FOR THE SODIUM TO LIMIT THE RATE SODIUM AND SULFUR COULD REACT IN THE EVENT OF A BETA TUBE FAILURE. PERFORMANCE TESTING DEMONSTRATED A CELL CAPACITY GREATER THAN THE 100 AH DESIGN VALUE, BUT THE ELECTRICAL RESISTANCE WAS APPROXIMATELY 30% GREATER THAN THE DESIGN VALUE. TWO CONCEPTS FOR A 100-KWH BATTERY MODULE WERE INVESTIGATED. THE FIRST USES FORCED-CONVECTION NITROGEN COOLING. THE SECOND USES LIQUID ORGANIC COOLANT; IT IS MORE COMPACT AND LESS COSTLY, AND PROVIDES BETTER TEMPERATURE CONTROL. HOWEVER, THE ORGANIC COOLANT DESIGN INTRODUCES POTENTIAL FIRE HAZARDS AND CORROSION CONCERNS. THE USE OF BETA'' ELECTROLYTE IN TEST CELLS WAS DEFERRED IN FAVOR OF BETA ELECTROLYTE BECAUSE THE RESISTANCE OF THE BETA'' WAS FOUND TO INCREASE RAPIDLY WITH TIME AND THE CERAMIC HAD A SHORT LIFETIME. THUS, THE ADVANTAGES OF THE LOW INITIAL RESISTIVITY OF BETA'' COMPARED TO BETA WERE LOST AFTER A FEW CYCLES OF OPERATION. THE DOPED CHROMIZED CELL CONTAINERS CONTINUED TO SHOW EXCELLENT CORROSION RESISTANCE DURING CELL TESTS OF UP TO 17 MONTHS' DURATION. A MODEL WAS DEVELOPED AND EXPERIMENTS WERE PERFORMED TO CHARACTERIZE THE PERFORMANCE OF THE RESISTIVE MAT BETWEEN THE POLYSULFIDES AND THE CERAMIC ELECTROLYTE. ALSO, A NEW MEASUREMENT OF THE ENTROPY CHANGE ASSOCIATED WITH THE SODIUM-SULFUR REACTION WAS COMPLETED. THESE MEASURED VALUES ARE LOWER THAN PREVIOUSLY PUBLISHED VALUES. IN EXTERIOR SEAL DEVELOPMENT, THE THERMOCOMPRESSION BOND SEALS WERE SUCCESSFULLY USED WITH FULL-SIZED CELLS, AND TESTS SHOWED SEAL STRENGTH OF APPROX. 2.76 X 10SSUP 07 PASCALS (APPROX. 4000 PSI).
DESCRIPTORS	ALUMINIUM OXIDES;COOLANTS;CORROSION RESISTANCE: D;ELECTRIC CONDUCTIVITY: D;ELECTROLYTES: Q2,D;EXPERIMENTAL DATA: D;GRAPHS: D;HAZARDS;OFF-PEAK ENERGY STORAGE: T1;PERFORMANCE TESTING: Q2,D;SAFETY: Q2;SEALS: Q2,D;SERVICE LIFE: D;SODIUM-SULFUR BATTERIES: Q1,M2,D

B-3

ACCESSION NO. 80C0071496
TITLE MATERIALS REQUIREMENTS IN LIAL/LICL-KCL/FES/SUB X/ SECONDARY BATTERIES
AUTHORS SMAGA, J.A.; MRAZEK, F.C.; MYLES, K.M.; BATTLES, J.E.
AUTHOR AFF ARGONNE NATIONAL LAB., IL
TITLE(MONO) MATERIALS CONSIDERATIONS IN LIQUID METALS SYSTEMS IN POWER GENERATION
EDITOR OR COMP HOFFMAN, N.J.; WHITLOW, G.A. (EDS.
SEC REPT NO CONF-760306--(EXC)
PAGE NO 52-64
CONF TITLE NACE MEETING ON CORROSION
CONF PLACE HOUSTON, TX, USA
CONF DATE 6 MAR 1976
PUBL LOC NATIONAL ASSOCIATION OF CORROSION ENGINEERS, HOUSTON, TX
DATE 1976
CATEGORIES EDB-360105;250900
PRIMARY CAT EDB-360105
ABSTRACT SEVERAL STATEMENTS CAN BE MADE CONCERNING THE RESULTS OF BOTH STATIC CORROSION TESTS IN SELECTED CORROSIVE MEDIA AND POSTOPERATIVE EXAMINATION OF CELLS: (1) THE CORROSION RESISTANCE OF METALLIC AND CERAMIC MATERIALS DECREASES WITH INCREASED TEMPERATURE THROUGH THE 400 TO 500 C RANGE. THIS ACCELERATION IN CORROSION ATTACK ARGUES STRONGLY FOR THE OPERATION OF LIAL/FES/SUB X/ CELLS AT TEMPERATURES BELOW 450 C.

B-4

ACCESSION NO. 80J0077169
TITLE CALCULATED GUIDE FOR SELECTING STAND-BY BATTERIES
AUTHORS BELMONT, T.K.
AUTHOR AFF NIFE, INC. LINCOLN, RI
PUB DESC SPEC. ENG., V. 41, NO. 6, PP. 86-89
DATE JUN 1979
CATEGORIES EDB-250902;250904
PRIMARY CAT EDB-250902
ABSTRACT LEAD-ACID AND NICKEL-CADMIUM SYSTEMS ARE THE TWO SECONDARY BATTERY SYSTEMS EVALUATED MOST OFTEN FOR STAND-BY SERVICE. ONE OF THE MOST IMPORTANT CHARACTERISTICS OF A SECONDARY BATTERY IS THE NUMBER OF TIMES IT CAN BE RECHARGED. NICKEL-CADMIUM BATTERIES TYPICALLY CAN BE RECHARGED UP TO SEVERAL THOUSAND TIMES. THEY CAN BE RECHARGED AT A WIDE RANGE OF RATES FROM A FLOAT CHARGE OF MILLIAMPERES TO AN ''OVERNIGHT'' CHARGE OF 6 TO 12 HOURS, ''QUICK CHARGE'' IN 4 TO 6 HOURS TO A ''FAST CHARGE'' IN AS LITTLE AS 15 MINUTES. IN APPLICATIONS WHERE BATTERIES ARE IN FLOAT STAND-BY SERVICE WITH INFREQUENT DEEP DISCHARGES, BATTERY LIFE CAN BE 25 TO 30 YEARS. THIS LONGEVITY IS ALSO ACCOMPANIED BY IMMUNITY TO SUDDEN CATASTROPHIC PERFORMANCE FAILURES WHICH DEMONSTRATES A VERY HIGH DEMAND RELIABILITY THAT IS SO VITAL IN STAND-BY POWER SYSTEMS. NICKEL-CADMIUM POCKET PLATE BATTERIES FOR STAND-BY BATTERY SYSTEMS EXHIBIT HIGH RATE DISCHARGE PERFORMANCE FOR APPLICATIONS DEMANDING A HEAVY SURGE OF CURRENT FOR SHORT PERIODS SUCH AS ENGINE/TURBINE STARTING, SWITCHGEAR CONTROL, INVERTER SUPPLY, ETC. ACID REACTION CREATES A NUMBER OF POTENTIAL PROBLEM AREAS COMMON TO ALMOST ALL TYPES OF LEAD-ACID CONSTRUCTION, AND LEADS TO INCREASING DEGRADATION OF BATTERY PERFORMANCE RELIABILITY IN TIME.
DESCRIPTORS EVALUATION: Q1,Q2;INDUSTRIAL PLANTS;LEAD-ACID BATTERIES: T2; NICKEL-CADMIUM BATTERIES: T1;PERFORMANCE;POWER SUPPLIES;SERVICE LIFE

B-5

ACCESSION NO. 80V0065982
TITLE SODIUM-SULFUR BATTERY: A PROGRESS REPORT
AUTHORS TOPOUZIAN, A. ; MARLOR, R.A.
AUTHOR AFF FORD MOTOR CO., DEARBORN, MI
TITLE(MONO) TWENTY-EIGHTH POWER SOURCES SYMPOSIUM
SEC REPT NO CONF-780624--
PAGE NO 7-11
CONF TITLE POWER SOURCES SYMPOSIUM
CONF PLACE ATLANTIC CITY, NJ, USA
CONF DATE 12 JUN 1978
PUBL LOC ELECTROCHEMICAL SOCIETY, INCORPORATED, PRINCETON, NJ
DATE 1978
CATEGORIES EDB-250903
PRIMARY CAT EDB-250903
AUGMENTATION 1 MW
ABSTRACT THE STATUS OF WORK ON THE DEVELOPMENT OF A 1-MW LOAD-LEVELING BATTERY IS SUMMARIZED. EMPHASIS WAS ON THE EVALUATION OF SULFUR CONTAINER MATERIALS AND COATINGS AS ACTUAL HARDWARE FOR EXPLORATORY CELLS. RESULTS OF PERFORMANCE TESTING OF SEVERAL TYPES OF CELLS ARE GIVEN; CORROSION WAS A BIG FACTOR IN LIMITING SERVICE LIFE. SAFETY TESTS DEMONSTRATED THE EFFECTIVENESS OF USING A STEEL TUBE INSIDE THE ELECTROLYTE TO LIMIT THE AMOUNT OF SODIUM NEAR THE ELECTROLYTE, TO PREVENT A CATASTROPHIC REACTION IN CASE OF INTERNAL CELL FAILURE. A DESCRIPTION OF RECENTLY CONSTRUCTED TEST FACILITIES IS GIVEN. NA/S CELLS CONTINUE TO SHOW POTENTIAL. 10 FIGURES, 5 TABLES. (RWR)
DESCRIPTORS CATHODES: Q1,D;CORROSION PROTECTION: D;EXPERIMENTAL DATA: D; HIGH TEMPERATURE: D;ISOLATED VALUES: D;MATERIALS: D;OFF-PEAK ENERGY STORAGE: M2;PERFORMANCE TESTING: D;POWER RANGE 1-10 KW: D;PROTECTIVE COATINGS: D;RESEARCH PROGRAMS;SAFETY;SERVICE LIFE: D;SODIUM-SULFUR BATTERIES: M1,Q2,D

B-6

ACCESSION NO.	80Y0065926
TITLE	CURRENT STATUS OF THE HOLLOW FIBER SODIUM-SULFUR CELL
AUTHORS	TSANG, F.Y.; ANAND, J.; LEVINE, C.A.
AUTHOR AFF	DOW CHEMICAL, WALNUT CREEK, CA
TITLE (MONO)	TWENTY-EIGHTH POWER SOURCES SYMPOSIUM
SEC REPT NO	CONF-780624--
PAGE NO	12-14
CONF TITLE	POWER SOURCES SYMPOSIUM
CONF PLACE	ATLANTIC CITY, NJ, USA
CONF DATE	12 JUN 1978
PUBL LOC	ELECTROCHEMICAL SOCIETY, INCORPORATED, PRINCETON, NJ
DATE	1978
CATEGORIES	EDB-250902
PRIMARY CAT	EDB-250902
AUGMENTATION	0.5- AND 5-AH
ABSTRACT	THE DOW NA/S CELL IS DESCRIBED, AS WELL AS ITS CHARACTERISTICS WITH RESPECT TO POSSIBLE APPLICATIONS. THE PERFORMANCE OF 0.5- AND 5-AH RESEARCH CELLS IS DISCUSSED; ONE OF THE FORMER LASTED 384 DAYS, AND UNDERWENT 9008 CYCLES AT 29% DEPTH OF DISCHARGE. FOUR FAILURE MODES WERE IDENTIFIED, AND CORRECTIVE STEPS ARE BEING TAKEN. ESTIMATED BATTERY COST IS IN THE RANGE OF $25 TO $30 PER KWH. 2 FIGURES, 2 TABLES. (WHK)
DESCRIPTORS	COST: D;ELECTRIC-POWERED VEHICLES: M3;ELECTROMOTIVE FORCE: D; EXPERIMENTAL DATA: D;FAILURES;ISOLATED VALUES: D;OFF-PEAK ENERGY STORAGE: M2;PERFORMANCE: Q1,D;SERVICE LIFE: D; SODIUM-SULFUR BATTERIES: M1,Q2,Q3,D

	RESEARCH AREAS, ENERGY CONVERSION AND ENERGY STORAGE AND MANAGEMENT, IDENTIFIED IN THE OVERVIEW AND STRATEGY DOCUMENT (EPRI-PS--1141-SR). AMONG THE R AND D GOALS ESTABLISHED FOR THESE AREAS, THE ONES MOST PERTINENT TO THE DIVISION'S ACTIVITIES ARE TO: (1) DEVELOP ADVANCED, COST-EFFECTIVE SYSTEMS FOR GENERATION OF ELECTRICITY; (2) PROVIDE SYSTEMS AND EQUIPMENT THAT WILL PERMIT ECONOMICAL ENERGY STORAGE AND WORKABLE CONCEPTS FOR MANAGEMENT OF ELECTRIC LOADS; AND (3) DEVELOP TECHNICAL ADVANCES TO ACHIEVE CONSERVATION OF ENERGY AND OTHER RESOURCES THROUGH EFFICIENT USE OF ELECTRICITY. THE FOLLOWING PROGRAMS ARE DESCRIBED IN DETAIL: ENERGY STORAGE; FUEL CELLS AND CHEMICAL ENERGY CONVERSION; AND ENERGY UTILIZATION AND CONSERVATION.
DESCRIPTORS	ELECTRIC POWER: T3;ENERGY CONVERSION: T;ENERGY EFFICIENCY: T,Q3; ENERGY STORAGE: T,Q1,Q2;EPRI: T;FUEL CELLS: T;LOAD MANAGEMENT: T2;POWER GENERATION: T1;RESEARCH PROGRAMS: Q1,Q2,Q3

B-7

ACCESSION NO.	80R0065160
TITLE (MONO)	HANDBOOK FOR BATTERY ENERGY STORAGE PHOTOVOLTAIC POWER SYSTEMS. FINAL REPORT
CORPORATE AUTH	BECHTEL NATIONAL, INC., SAN FRANCISCO, CA (USA)
SEC REPT NO	SAND--80-7022
PAGE NO	126
AVAILABILITY	NTIS, PC A07/MF A01.
CONTRACT NO	CONTRACT ET-78-C-03-2192
DATE	NOV 1979
CATEGORIES	EDB-140600;250904;250902
PRIMARY CAT	EDB-140600
REPORT NO	SAN--2192-T1
ABSTRACT	THE PRINCIPAL PURPOSE OF THIS HANDBOOK IS TO PROVIDE THE PHOTOVOLTAIC SYSTEM DESIGNER WITH A SOURCE OF INTERFACE DESIGN CONSIDERATIONS, AS WELL AS PERFORMANCE, COST AND OTHER NECESSARY INFORMATION ON BATTERIES. THE HANDBOOK IS ORIENTED TOWARDS SYSTEMS ANALYSTS, ENGINEERS AND DESIGNERS INVOLVED WITH THE DEVELOPMENT, DESIGN AND EVALUATION OF PHOTOVOLTAIC POWER SYSTEMS. TO THIS END, THIS HANDBOOK EMPHASIZES THE INFORMATION NEEDED TO SUCCESSFULLY SELECT AND INTERFACE THE BATTERY WITH THE REMAINDER OF THE POWER SYSTEM. DETAILS OF BATTERY DESIGN, CONSTRUCTION AND THEORY OF OPERATION ARE ADDRESSED ONLY AS NEEDED TO PROVIDE THE PHOTOVOLTAIC SYSTEM DESIGNER A BETTER UNDERSTANDING OF BATTERY CHARACTERISTICS. THIS HANDBOOK CONTAINS INFORMATION ON COMMERCIALLY AVAILABLE BATTERIES, AS WELL AS BATTERY TYPES PRESENTLY UNDER DEVELOPMENT THAT HAVE POTENTIAL FOR FUTURE APPLICATION IN PHOTOVOLTAIC POWER SYSTEMS. A GLOSSARY OF TERMINOLOGY AND COMPARATIVE CHARTS WHICH BRIEFLY SUMMARIZE THE PRINCIPAL CHARACTERISTICS OF COMMERCIALLY AVAILABLE, NEAR-TERM AND ADVANCED STORAGE BATTERY SYSTEMS ARE PRESENTED. A GENERAL DISCUSSION OF BATTERY/PHOTOVOLTAIC POWER SYSTEM INTERFACE DESIGN CONSIDERATIONS IS GIVEN. A DISCUSSION OF CHARACTERISTICS OF COMMERCIALLY AVAILABLE BATTERIES SUITABLE FOR PHOTOVOLTAIC APPLICATIONS AND A PRESENTATION OF PROJECTED CHARACTERISTICS FOR NEAR-TERM AND ADVANCED BATTERY SYSTEMS ARE INCLUDED. (WHK)
DESCRIPTORS	AUXILIARY SYSTEMS;BATTERY CHARGING;CAPACITY;CHARGE STATE;COST; DATA;DESIGN;ELECTRIC BATTERIES: T2;ELECTRICAL PROPERTIES;ENERGY STORAGE SYSTEMS: Q1;ENVIRONMENTAL IMPACTS;EQUIPMENT INTERFACES; GRAPHS;LEAD-ACID BATTERIES;MAINTENANCE;MANUALS: Q2; MANUFACTURERS;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES; PERFORMANCE: Q2;PHOTOVOLTAIC POWER SUPPLIES: T1;SAFETY;SERVICE LIFE;SOLAR BATTERY CHARGERS;SYSTEMS ANALYSIS

B-8

ACCESSION NO.	80R0066041
TITLE(MONO)	PARAMETRIC ANALYSIS OF RESIDENTIAL GRID-CONNECTED PHOTOVOLTAIC SYSTEMS WITH STORAGE
EDITOR OR COMP	CASKEY, D.L.; CASKEY, B.C.; ARONSON, E.A.
CORPORATE AUTH	SANDIA LABS., ALBUQUERQUE, NM (USA)
PAGE NO	73
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EY-76-C-04-0789
DATE	MAR 1980
CATEGORIES	EDB-140000;250904
PRIMARY CAT	EDB-140000
REPORT NO	SAND--79-2331
ABSTRACT	THE SANDIA LABORATORIES' OPTIMIZING COMPUTER CODE, SOLSTOR, HAS BEEN USED TO INVESTIGATE THE ROLE OF BATTERY STORAGE IN A RESIDENTIAL PHOTOVOLTAIC SYSTEM. THE SYSTEM IS CONNECTED TO THE UTILITY GRID, AND TIME-OF-DAY (TOD) PRICING AND SELL-BACK POLICIES ARE CONSIDERED. SEVERAL PARAMETERS, INCLUDING GEOGRAPHIC LOCATION, WERE VARIED, RESULTING IN A LARGE NUMBER OF SYSTEMS OPTIMIZED WITH RESPECT TO THE 20-YEAR LIFE CYCLE COST OF PROVIDING ENERGY FOR AN ALL-ELECTRIC HOME. CONCLUSIONS ARE THAT BATTERY COSTS OF AROUND $100/KWH OR LESS ARE REQUIRED FOR STORAGE TO BE ECONOMICALLY BENEFICIAL, WHEN COMBINED WITH TOD RATIOS OF 3:1 OR MORE, OR SELL-BACK RATIOS OF 0.5 OR LESS.
DESCRIPTORS	ARIZONA;COMPUTER CALCULATIONS;COST;ECONOMIC ANALYSIS: Q2; ECONOMICS: Q3,Q4;ELECTRIC BATTERIES: T3;ELECTRIC POWER;ENERGY STORAGE SYSTEMS: T4,Q2;ENERGY SUBSTITUTION EQUIVALENT; INTERCONNECTED POWER SYSTEMS;LIFE-CYCLE COST;MATHEMATICAL MODELS;MISSOURI;NEW YORK;PARAMETRIC ANALYSIS: Q2;PEAK-LOAD PRICING;PHOTOVOLTAIC POWER SUPPLIES: T2,Q1;RATE STRUCTURE; REGIONAL ANALYSIS;RESIDENTIAL BUILDINGS: T1;SELLBACK

B-9

ACCESSION NO.	80P0055822
PATENT NO	US PATENT 4,160,069
TITLE(MONO)	ELECTRICALLY CONDUCTIVE AND CORROSION RESISTANT CURRENT COLLECTOR AND/OR CONTAINER
EDITOR OR COMP	JOHNSON, D.W.; MILLER, G.R.; BEUTLER, P.S.
PAT ASSIGNEE	TO UNIV. OF UTAH
FILED DATE	FILED DATE 18 FEB 1977
PAGE NO	20
DATE	3 JUL 1979
CATEGORIES	EDB-250903;360201;360204
PRIMARY CAT	EDB-250903
AUGMENTATION	PATENT
ABSTRACT	AN IMPROVED ELECTRICALLY CONDUCTIVE CURRENT COLLECTOR SUITABLE FOR USE IN HIGH TEMPERATURE APPLICATIONS IN THE PRESENCE OF CORROSIVE ENVIRONMENTS COMPRISES A HIGH-STRENGTH, NONCORROSIVE, ELECTRONICALLY CONDUCTIVE CERAMIC MEMBER THAT SERVES AS THE PRIMARY LOAD BEARING ELEMENT FOR THE CURRENT COLLECTOR AND A HIGHLY ELECTRONICALLY CONDUCTIVE METAL CLADDING INTIMATELY ATTACHED TO A SUBSTANTIAL PORTION OF ONE SURFACE OF THE CERAMIC MEMBER AND ADAPTED TO DIRECT CURRENT FLOW THROUGH THE CERAMIC MEMBER AND TO SHUNT THE CURRENT BETWEEN THE MEMBER AND AN EXTERNAL CONTACT. THE DISCLOSED CURRENT COLLECTORS ARE IDEALLY SUITED FOR USE AS CURRENT COLLECTORS AND CURRENT COLLECTOR/CONTAINERS FOR ELECTRICAL CONVERSION DEVICES SUCH AS THE SODIUM/SULFUR BATTERY AND THE LIKE. ALSO DISCLOSED ARE TWO PROCESSES FOR PREPARING TANTALUM- OR NIOBIUM-DOPED RUTILE TITANIUM DIOXIDE. THE ELECTRONICALLY CONDUCTIVE CERAMICS PRODUCED BY THESE METHODS ARE IDEALLY SUITED FOR USE AS THE CERAMIC IN THE DISCLOSED CURRENT COLLECTOR.
DESCRIPTORS	CHEMICAL PREPARATION: Q2;CONDUCTOR DEVICES: Q1;CONTAINERS: Q1; DOPED MATERIALS;ELECTRIC CONDUCTIVITY: Q2;HIGH TEMPERATURE; NIOBIUM ADDITIONS;RUTILE: M2;SODIUM-SULFUR BATTERIES: M1; TANTALUM ADDITIONS;TEMPERATURE DEPENDENCE

B-10

ACCESSION NO.	80R0049799
TITLE(MONO)	ENERGY STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION: 1979 STUDY. VOLUME 2. DETAILED REPORT
EDITOR OR COMP	FORSBERG, H.C.; ANDERSON, C.J.; BEHRIN, E.
CORPORATE AUTH	CALIFORNIA UNIV., LIVERMORE (USA). LAWRENCE LIVERMORE LAB.
PAGE NO	288
AVAILABILITY	DEP. NTIS, PC A13/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-48
DATE	15 DEC 1979
CATEGORIES	EDB-330300;250600;250500;250900
PRIMARY CAT	EDB-330300
REPORT NO	UCRL--52841(VOL.2)
ABSTRACT	THE RESULTS ARE GIVEN FOR FY 1979 OF A NATIONAL MULTILABORATORY STUDY OF ENERGY-STORAGE PROPULSION SYSTEMS FOR AUTOMOBILES. THE FINDINGS OF THE FOUR PARTICIPATING PANELS ARE PRESENTED, INCLUDING A TECHNICAL AND COST UPDATE FOR THE ENERGY-STORAGE DEVICES AND RESULTANT VEHICLES. IN ADDITION, AN EVALUATION METHODOLOGY IS DESCRIBED FOR NATIONAL ENERGY AND MARKET IMPACT. A MANUFACTURING AND SERVICE INFRASTRUCTURE STUDY IS INTRODUCED, AND AN EXAMINATION IS MADE OF CERTAIN SPECIALTY MARKETS. THE 1979 STUDY CONTINUES TO PROJECT THE ENERGY-STORAGE DEVICE CHARACTERISTICS AND EVALUATES THE RESULTING VEHICLES. THE SYSTEMS ANALYZED INCLUDED SEVERAL THAT WERE NOT CONSIDERED IN THE 1978 WORK, AND THREE THAT HAD NOT BEEN PREVIOUSLY EVALUATED: THE SHORT-RANGE BUT HIGH-PERFORMANCE ALL-ELECTRIC VEHICLE; THE HYDROGEN-FUEL-CELL-POWERED ELECTRIC; AND THE ADVANCED-BATTERY EV, POWER BOOSTED WITH AN ADVANCED-DESIGN, FIBER-COMPOSITE FLYWHEEL.
DESCRIPTORS	AUTOMOBILES: T3,D;COST;EFFICIENCY: D;ELECTRIC BATTERIES; ELECTRIC-POWERED VEHICLES: T1,D;ENERGY STORAGE SYSTEMS: T4,Q3,D; EVALUATION: Q4;FLYWHEEL ENERGY STORAGE;FLYWHEEL-POWERED VEHICLES: T5;GRAPHS: D;HYBRID ELECTRIC-POWERED VEHICLES: T2,D; HYDROGEN FUEL CELLS;INTERNAL COMBUSTION ENGINES;MATERIALS; NUMERICAL DATA: D;PHYSICAL PROPERTIES;PROPULSION: Q3; SPECIFICATIONS: Q1,Q2,Q4,Q5,D;TABLES: D

B-11

ACCESSION NO.	80R0046327
TITLE(MONO)	MATHEMATICAL MODELLING OF THE LITHIUM-ALUMINUM, IRON SULFIDE BATTERY
EDITOR OR COMP	POLLARD, R.
CORPORATE AUTH	CALIFORNIA UNIV., BERKELEY (USA). LAWRENCE BERKELEY LAB.
PAGE NO	167
AVAILABILITY	DEP. NTIS, PC A08/MF A01.
CONTRACT NO	CONTRACT W-7405-ENG-48
DATE	DEC 1979
DROP NOTE	THESIS
CATEGORIES	EDB-250902;250903
PRIMARY CAT	EDB-250902
AUGMENTATION	BATHY, FOR CURRENT, OVERPOTENTIAL, AND REACTION RATE DISTRIBUTION FOR LIAL/FES CELL, IN FORTRAN
REPORT NO	LBL--10197
ABSTRACT	THE LIAL/LICL,KCL/FES HIGH-TEMPERATURE BATTERY IS A CANDIDATE FOR OFF-PEAK ENERGY STORAGE AND FOR ELECTRIC VEHICLE PROPULSION. A MATHEMATICAL MODEL IS PRESENTED WHICH IS ABLE TO PREDICT THE OPERATIONAL CHARACTERISTICS OF THE CELL AND OBTAIN PERTINENT INFORMATION FOR ITS DESIGN AND OPTIMIZATION. MATERIAL BALANCES AND FLUX EQUATIONS, BASED ON THE MACROSCOPIC THEORY OF POROUS ELECTRODES, ARE DERIVED FOR THE BINARY MOLTEN SALT ELECTROLYTE. THESE EQUATIONS, TOGETHER WITH OHM'S LAW AND RELATIONSHIPS FOR ELECTRODE KINETICS, ARE USED TO DESCRIBE THE TIME-DEPENDENT AND POSITION-DEPENDENT BEHAVIOR OF THE SYSTEM. THE MODEL CONSIDERS A WHOLE PRISMATIC CELL, WHICH CONSISTS OF NEGATIVE ELECTRODE, SEPARATOR, ELECTROLYTE RESERVOIR, AND POSITIVE ELECTRODE. PHYSICAL PHENOMENA DESCRIBED ARE OHMIC POTENTIAL DROP AND DIFFUSION POTENTIAL IN THE ELECTROLYTE, CHANGES IN POROSITY AND ELECTROLYTE COMPOSITION DUE TO ELECTROCHEMICAL REACTIONS, LOCAL REACTION RATES, AND DIFFUSION, CONVECTION, AND MIGRATION OF ELECTROLYTE. IN ADDITION, THE ANALYSIS INCLUDES FINITE MATRIX CONDUCTIVITIES, VARIABLE PHYSICAL PROPERTIES, AND THE POSSIBILITY OF SPECIFIC SIMULTANEOUS REACTIONS IN THE POSITIVE ELECTRODE. THE THEORETICAL RESULTS SHOW MANY OF THE TRENDS IN BEHAVIOR OBSERVED EXPERIMENTALLY. THE EFFECTS OF STATE OF CHARGE, INITIAL ELECTROLYTE COMPOSITION, CELL TEMPERATURE, AND CURRENT DENSITY ARE PRESENTED, AND FACTORS THAT CAN LIMIT CELL PERFORMANCE ARE IDENTIFIED. THE INFLUENCE OF A PERIOD OF RELAXATION BETWEEN THE END OF DISCHARGE AND THE SUBSEQUENT CHARGE IS ALSO INVESTIGATED. FURTHERMORE, A SEPARATE, ANALYTIC TREATMENT OF POROUS ELECTRODES IS DEVELOPED IN ORDER TO CLARIFY THE NATURE OF THE HIGHLY NONUNIFORM INITIAL REACTION DISTRIBUTIONS THAT ARE OBTAINED WITH HIGH EXCHANGE CURRENT DENSITIES. 29 FIGURES, 6 TABLES.
DESCRIPTORS	ALUMINIUM ALLOYS;B CODES: G4;BATTERY CHARGING;BINARY ALLOY SYSTEMS;CHARGE STATE;CHEMICAL COMPOSITION: D;CHEMICAL REACTION KINETICS;COMPUTER CODES: M4;CONTINUITY EQUATIONS;CURRENT DENSITY: D;DESIGN;ELECTRIC-POWERED VEHICLES: T3; ELECTROCHEMISTRY;ELECTRODES;ELECTROLYTES: D;ELECTROMOTIVE FORCE: D;FORTRAN;GRAPHS: D;HIGH TEMPERATURE;IRON SULFIDES; LITHIUM ALLOYS;LITHIUM CHLORIDES;LITHIUM-SULFUR BATTERIES: T1,Q2,Q3,D;MASS TRANSFER;MATHEMATICAL MODELS: Q1,D;OFF-PEAK ENERGY STORAGE: T2;OPERATION;OPTIMIZATION;POTASSIUM CHLORIDES; TEMPERATURE DEPENDENCE;THEORETICAL DATA: D;TIME DEPENDENCE

B-12

ACCESSION NO.	80R0028126
TITLE(MONO)	LEAD BATTERIES (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1964-JUL 1979
EDITOR OR COMP	CAVAGNARO, D.
CORPORATE AUTH	NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA (USA)
PAGE NO	169
AVAILABILITY	NTIS PCN01/MF N01.
DATE	AUG 1979
CATEGORIES	EDB-250900;500300
PRIMARY CAT	EDB-250900
REPORT NO	NTIS/PS--79/0780
ABSTRACT	THE DESIGN, DEVELOPMENT, COMPONENTS, FABRICATION, CHEMISTRY, AND TESTING OF LEAD BATTERIES ARE CITED IN THIS COMPILATION OF FEDERALLY-FUNDED RESEARCH. SPECIFIC APPLICATIONS FOR SPACECRAFT, CONSUMER PRODUCTS, AND ELECTRIC VEHICLES ARE COVERED. STUDIES ON LEAD RECOVERY FROM BATTERY SCRAP ARE COVERED. SEVERAL ABSTRACTS ON LEAD TOXICITY IN INDUSTRIAL PLANTS ARE ALSO CITED. (THIS UPDATED BIBLIOGRAPHY CONTAINS 163 ABSTRACTS, 39 OF WHICH ARE NEW ENTRIES TO THE PREVIOUS EDITION.)
DESCRIPTORS	BATTERY SEPARATORS;BIBLIOGRAPHIES: Q1;CHEMICAL REACTIONS;DESIGN; ELECTRIC-POWERED VEHICLES: T2;ELECTROCHEMISTRY;ELECTRODES; ELECTROLYTES;FABRICATION;INDUSTRIAL PLANTS;LEAD T3;LEAD-ACID BATTERIES: T1,Q2;OFF-PEAK ENERGY STORAGE;RELIABILITY;SPACE VEHICLES;TESTING;TOXICITY: Q3;TRUCKS;WASTE PROCESSING

B-13

ACCESSION NO.	80C0027420
TITLE	DESIGN AND CONSTRUCTION OF A 100 KW PHOTOVOLTAIC REMOTE

	STAND-ALONE POWER SYSTEM
AUTHORS	LYON, E.F.
AUTHOR AFF	MASSACHUSETTS INST. OF TECH., LEXINGTON
TITLE(MONO)	2ND E.C. PHOTOVOLTAIC SOLAR ENERGY CONFERENCE
EDITOR OR COMP	VAN OVERSTRAETEN, R.J.; PALZ, W. (EDS.
SEC REPT NO	EUR--6370; CONF-790457--
PAGE NO	593-600
CONF TITLE	1979 PHOTOVALTAIC SOLAR ENERGY CONFERENCE
CONF PLACE	WEST BERLIN, F.R. GERMANY
CONF DATE	23 APR 1979
PUBL LOC	D. REIDEL PUBLISHING CO., HINGHAM, MA
DATE	1979
CATEGORIES	EDB-140600;250904
PRIMARY CAT	EDB-140600
ABSTRACT	A 100 KW PEAK PHOTOVOLTAIC (PV) POWER SYSTEM IS NOW UNDER CONSTRUCTION IN A REMOTE NATIONAL PARK IN SOUTHEASTERN UTAH. SPONSORED JOINTLY BY THE UNITED STATES DEPARTMENT OF ENERGY AND THE NATIONAL PARK SERVICE, THE SYSTEM WILL INCLUDE THE LARGEST FLAT-PLATE ARRAY FIELD IN THE WORLD. OVER 200,000 N ON P SILICON PV CELLS WILL BE CONTAINED IN THE GLASS-COVERED ARRAY MODULES. ENERGY FROM THE ARRAY WILL BE SUPPLIED TO SITE LOADS AS AC POWER OR STORED IN A LARGE LEAD-CALCIUM BATTERY. ALTHOUGH MOST BUILDINGS AT THIS REMOTE COMMUNITY USE LP GAS FOR HEATING, THE PV SYSTEM WILL SUPPLY ALL HEATING AND COOLING REQUIREMENTS FOR A CENTRAL PV BUILDING FROM SOLAR PV POWER. THE PARK, WITH ITS DIVERSIFIED MIX OF LOADS AND ITS LACK OF PUBLIC UTILITY POWER, IS TYPICAL OF TENS OF THOUSANDS OF REMOTE SETTLEMENTS IN THE WORLD WHICH PRESENTLY RELY ON DIESEL-POWERED GENERATORS FOR ELECTRIC POWER. UPON COMPLETION OF THE PV SYSTEM LATE IN 1979, THE PRESENT DIESEL WILL BE RELEGATED TO A BACKUP ROLE AND IS EXPECTED TO SUPPLY LESS THAN 15% OF THE ANNUAL ELECTRICAL CONSUMPTION AT THE SITE.
DESCRIPTORS	BUILDINGS: T2;CONSTRUCTION;COOLING SYSTEMS;DESIGN: Q1;HEATING SYSTEMS;LEAD-ACID BATTERIES;OPERATION;PHOTOVOLTAIC POWER SUPPLIES: T1,Q2;POWER RANGE 10-100 KW;REMOTE AREAS;SILICON SOLAR CELLS;UTAH

B-14

ACCESSION NO.	80C0027357
TITLE	BATTERIES FOR SOLAR ELECTRICITY
AUTHORS	JENSEN, J. ; PERRAM, C.; DELL, R.M.
AUTHOR AFF	ODENSE UNIV., DENMARK
TITLE(MONO)	2ND E.C. PHOTOVOLTAIC SOLAR ENERGY CONFERENCE
EDITOR OR COMP	VAN OVERSTRAETEN, R.J.; PALZ, W. (EDS.
SEC REPT NO	EUR--6370; CONF-790457--
PAGE NO	610-620
CONF TITLE	1979 PHOTOVALTAIC SOLAR ENERGY CONFERENCE
CONF PLACE	WEST BERLIN, F.R. GERMANY
CONF DATE	23 APR 1979
PUBL LOC	D. REIDEL PUBLISHING CO., HINGHAM, MA
DATE	1979
CATEGORIES	EDB-140501;250903
PRIMARY CAT	EDB-140501
ABSTRACT	THE SMALL SCALE STORAGE OF SOLAR ELECTRICITY IN SITUATIONS WHERE NO MAINS BACK-UP SUPPLY IS AVAILABLE IS CONSIDERED. A SYSTEMS OPTIMIZATION STUDY OF THE SOLAR CELL/BATTERY INCLUDES AN ANALYSIS OF SOLAR CELL SIZE RELATED TO BATTERY CAPACITY FOR GIVEN INSULATION PATTERNS AND LOAD CONSTRAINTS. VARIOUS CANDIDATE BATTERIES ARE REVIEWED. APART FROM COST THE FOLLOWING PARAMETERS ARE GENERALLY IMPORTANT: LOW MAINTENANCE, LONG LIFETIME AND LARGE NUMBER OF CYCLES, HIGH CHARGE/DISCHARGE EFFICIENCY, AND GOOD CHARGE RETENTION. SEALED LEAD-ACID AND NICKEL-CADMIUM BATTERIES ARE THE ONLY OPTIONS AT PRESENT. IN THE MEDIUM TERM IT IS POSSIBLE THAT NICKEL-ZINC AND LITHIUM-ORGANIC ELECTROLYTE BATTERIES WILL ALSO HAVE A ROLE TO PLAY. IT IS CONCLUDED THAT IN THE LONG TERM AN ALL SOLID STATE, MAINTENANCE FREE LOW COST BATTERY IS NEEDED.
DESCRIPTORS	CAPACITY;COST;ELECTRIC BATTERIES: T1;ENERGY STORAGE SYSTEMS: Q1;LEAD-ACID BATTERIES;MAINTENANCE;NICKEL-CADMIUM BATTERIES;OPTIMIZATION;PERFORMANCE;PHOTOVOLTAIC POWER SUPPLIES: T1;SERVICE LIFE;SIZE;SPECIFICATIONS

B-15

ACCESSION NO. 80X0021793
TITLE(MONO) DEVELOPMENT OF FUEL CELL TECHNOLOGY FOR VEHICULAR APPLICATIONS. ANNUAL REPORT, OCTOBER 1, 1977-SEPTEMBER 30, 1978
EDITOR OR COMP MCBREEN, J.; TAYLOR, E.J.; KORDESCH, K.V.; KISSEL, G.; KULESA, F.; SRINIVASAN, S.
CORPORATE AUTH BROOKHAVEN NATIONAL LAB., UPTON, NY (USA)
PAGE NO 166
AVAILABILITY DEP. NTIS, PC A06/MF A01.
CONTRACT NO CONTRACT EY-76-C-02-0016
DATE MAY 1979
CATEGORIES EDB-300504;300501;330300;330400;250902;250904
PRIMARY CAT EDB-300504
REPORT NO BNL--51047
ABSTRACT A SURVEY OF THE PRESENT STATE-OF-THE-ART OF FUEL CELLS AND BATTERIES SUITABLE FOR HYBRID FUEL CELL/BATTERY POWER PLANTS IS PRESENTED. ALSO GIVEN ARE A SYSTEMS STUDY ON PHOSPHORIC ACID FUEL CELLS FOR TRANSPORTATION APPLICATIONS AND THE RESULTS OF AN EXPERIMENTAL STUDY OF PHOSPHORIC ACID AND ALKALINE FUEL CELLS UNDER CONDITIONS OF INTERMITTENT OPERATION. A REVIEW OF FUEL OPTIONS AND FUEL PROCESSING FOR FUEL CELLS IS INCLUDED. (WHK)
DESCRIPTORS ACID ELECTROLYTE FUEL CELLS;CLASSIFICATION;DESIGN;EFFICIENCY; ELECTRIC BATTERIES: T4,Q3;ELECTRIC-POWERED VEHICLES: T2;FUEL CELLS: T1,Q2,Q3;FUEL ECONOMY;FUEL SYSTEMS;FUELS;HYBRID ELECTRIC-POWERED VEHICLES: T3;HYDROGEN GENERATORS;LEAD-ACID BATTERIES;NICKEL-ZINC BATTERIES;OPTIMIZATION;PERFORMANCE: Q4; REVIEWS;SOLID ELECTROLYTES;TECHNOLOGY ASSESSMENT: Q1

B-16

ACCESSION NO. 80J0021412
TITLE NEW RESULTS WITH NA/S BATTERIES AND ASPECTS FOR THEIR PRACTICAL USE
AUTHORS FISCHER, W.; MEINHOLD, H.
AUTHOR AFF BROWN, BOVERI UND CIE A.G., HEIDELBERG (GERMANY, F.R.). ZENTRALES FORSCHUNGSLABOR
PUB DESC ELEKTR. ENERG. TECH., V. 24, NO. 1, PP. 1-6
DATE FEB 1979
LANGUAGE IN GERMAN
CATEGORIES EDB-250902;250904
PRIMARY CAT EDB-250902
ABSTRACT THE ARTICLE DESCRIBES THE LAYOUT AND FUNCTION OF THE NA/S CELL AS WELL AS THE STATE OF THE ART AND THE PROBLEMS WITH REGARD TO THE SOLID ELECTROLYTE, THE SULFUR ELECTRODE, CORROSION, SERVICE LIFE, AND THE FABRICATION OF A TEST BATTERY. POSSIBLE USES OF BATTERIES OF THIS KIND AS DRIVES FOR ELECTROVEHICLES AND FOR PEAK SHAVING IN ELECTRICITY NETWORKS ARE DISCUSSED.
DESCRIPTORS CATHODES;CORROSION;ELECTRIC-POWERED VEHICLES: T2;FABRICATION; OFF-PEAK ENERGY STORAGE: T3;PERFORMANCE: Q1;PERFORMANCE TESTING; SERVICE LIFE;SODIUM-SULFUR BATTERIES: T1,Q2,Q3;SOLID ELECTROLYTES;USES

CELLS: T2;PLANNING;POWER CONDITIONING CIRCUITS: Q1;POWER RANGE 10-100 KW;POWER SYSTEMS;PROPANE;REFORMER PROCESSES; SPECIFICATIONS

B-17

ACCESSION NO. 80J0016439
TITLE ANODIC CORROSION RATE MEASUREMENTS IN LICL-KCL EUTECTIC. 2. RESULTS ON NICKEL, MOLYBDENUM, AND STAINLESS STEEL
AUTHORS RALEIGH, D.O.; WHITE, J.T.; OGDEN, C.A.
AUTHOR AFF ROCKWELL INT, THOUSAND OAKS, CALIF
PUB DESC J. ELECTROCHEM. SOC., V. 126, NO. 7, PP. 1093-1099
DATE JUL 1979
CATEGORIES EDB-250903;360105
PRIMARY CAT EDB-250903
AUGMENTATION LITHIUM-IRON SULFIDE MOLTEN SALT BATTERY.
ABSTRACT THE ANODIC DISSOLUTION CHARACTERISTICS OF NICKEL, MOLYBDENUM, AND 304 STAINLESS STEEL HAVE BEEN EXAMINED IN PURE AND LI$SUB 2$S-SATURATED LICL-KCL EUTECTIC MELT. MOLYBDENUM AND NICKEL SHOW TAFEL-TYPE DISSOLUTION KINETICS IN PURE EUTECTIC WHICH PERMIT ESTIMATES OF LONG-TERM CORROSION RATES AS A FUNCTION OF VOLTAGE. NICKEL EXHIBITS A SHARP THRESHOLD POTENTIAL FOR DISSOLUTION IN LI$SUB 2$S-SATURATED MELT, FORMING A NONPASSIVTING NI$SUB 3$S$SUB 2$ LAYER. COMPARATIVE VOLTAMMETRY AND OPEN-CIRCUIT POTENTIAL MEASUREMENTS WITH IRON IN THIS MELT SUGGEST THAT CARE MAY BE REQUIRED IN USING NICKEL AS AN IRON SULFIDE CURRENT COLLECTOR. THE ANODIC DISSOLUTION OF 304 STAINLESS STEEL IN LI$SUB 2$S-SATURATED MELT APPEARS TO BE RATE LIMITED BY DIFFUSION THROUGH A REACTION LAYER, SHOWING A (TIME) $SUP -$/SUP 1/2/DEPENDENCE THAT MAY BE APPLICABLE TO LONG-TERM CORROSION PREDICTIONS.
DESCRIPTORS CATHODES: Q1;CORROSIVE EFFECTS: Q5,Q6,Q7;DISSOLUTION;ELECTRIC POTENTIAL;ELECTROCHEMICAL CORROSION: Q2,Q3,Q4;ELECTROCHEMISTRY; EUTECTICS;LITHIUM CHLORIDES: T5;LITHIUM SULFIDES: T7; LITHIUM-SULFUR BATTERIES: T1;MOLYBDENUM: T3;NICKEL: T2; POTASSIUM CHLORIDES: T6;STAINLESS STEEL-304: T4

B-18

ACCESSION NO. 80C0016423
TITLE(MONO) OVERVIEW OF NEAR-TERM BATTERY DEVELOPMENTS
TITLE(SERIAL) PAPER 763161(E)
EDITOR OR COMP YAO, N.P.; LUDWIG, F.A.; HORNSTRA, F.
PAGE NO 11
PUBL LOC ELECTRIC VEHICLE COUNCIL, NEW YORK, NY
DATE 1976
CATEGORIES EDB-250901
PRIMARY CAT EDB-250901
ABSTRACT THE NEAR-GERM BATTERY EFFORT, GEARED TO ELECTRIC VEHICLE (EV)

DEMONSTRATIONS IN 1981 TO 1984, STRESSES GOALS REQUIRING IMPROVEMENTS OVER EXISTING BATTERIES IN PERFORMANCE, CYCLE LIFE, AND COST. ARGONNE NATIONAL LABORATORIES IN PERFORMANCE, CYCLE LIFE, AND COST. ARGONNE NATIONAL LABORATORY IS MANAGING A NUMBER OF DOE-SPONSORED BATTERY R AND D SUBCONTRACTS (NICKEL/ZINC, LEAD-ACID, AND NICKEL/IRON SYSTEMS) REQUIRING THE SCHEDULED DELIVERY AND TESTING AT ARGONNE, UNDER UNIFORMLY APPLIED CONDITIONS, OF SEVERAL IMPROVED VERSIONS OF CELLS, MODULES, AND BATTERIES. EACH CONTRACT CULMINATES WITH THE DELIVERY AND TEST OF FIFTEEEN 20- TO 30-KWH EV BATTERIES IN 1980 AND 1981. THE NATIONAL BATTERY TEST LABORATORY (NBTL) AT ARGONNE INCLUDES 500-A FULLY AUTOMATED TEST STATIONS WHICH CAN INDEPENDENTLY TEST FULL-SIZE EV BATTERIES. THE TESTING CAPABILITIES AND TEST RESULTS AT THE NBTL ARE DISCUSSED. SUBCONTRACTOR R AND D EFFORTS TO DATE ARE PRESENTED AND ANALYZED. THE CONFIDENCE LEVEL IN ACHIEVING PROGRAM GOALS IS HIGH. 3 FIGURES, 4 TABLES.

DESCRIPTORS: ELECTRIC BATTERIES: T1,Q2;ELECTRIC-POWERED VEHICLES: T2; IRON-NICKEL BATTERIES;LEAD-ACID BATTERIES;NICKEL-ZINC BATTERIES; RESEARCH PROGRAMS: Q1;REVIEWS;TEST FACILITIES: Q1

B-19

ACCESSION NO. 80C0016421
TITLE 100MWH ZINC-CHLORINE PEAK-SHAVING BATTERY PLANTS
AUTHORS WARDE, C.J.; SYMONS, P.C.; WHITTLESEY, C.C.; CATHERINO, H.A.
AUTHOR AFF GULF AND WEST CO. ENERGY DEV ASSOC, MADISON HEIGHTS, MICH
PUB DESC PROC., INTERSOC. ENERGY CONVERS. ENG. CONF., V. 1, PP. 755-763
SEC REPT NO CONF-780801--P1
CONF TITLE 13. INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE
CONF PLACE SAN DIEGO, CA, USA
CONF DATE 20 AUG 1978
DATE 1978
CATEGORIES EDB-250901;200106
PRIMARY CAT EDB-250901
ABSTRACT ENERGY STORAGE IN COST-EFFECTIVE HIGH-EFFICIENCY BATTERY PLANTS WOULD PROVIDE AN ATTRACTIVE MEANS FOR THE ELECTRIC-UTILITY INDUSTRY TO CONSERVE NATURAL GAS AND OIL. THESE PLANTS SIZED IN THE 20-200MWH RANGE WOULD BE LOCATED AT SUBSTATIONS IN THE UTILITY SUBTRANSMISSION OR DISTRIBUTION NETWORK. ENERGY DEVELOPMENT ASSOCIATES HAS PREPARED THREE CONCEPTUAL DESIGNS OF A 100MWH ZINC-CHLORINE BATTERY PLANT FOR THIS APPLICATION. THE THREE DESIGNS, DESIGNATED MARKS 2, 3, AND 4, WERE ANALYZED FROM THE STANDPOINTS OF COST, EFFICIENCY, LAND USAGE, SAFETY, AND ENVIRONMENTAL IMPACT. MARK 4, BASED ON THE USE OF A 56KWH BATTERY MODULE, WAS FOUND TO BE OPTIMAL IN THE AREAS OF PERFORMANCE, SAFETY, AND MANUFACTURABILITY, WHILE COMPARING FAVORABLY IN COST AND RELIABILITY TO MARKS 2 AND 3.
DESCRIPTORS COST;DESIGN: Q2;EFFICIENCY;OFF-PEAK ENERGY STORAGE: T1; OPTIMIZATION;POWER RANGE 10-100 MW;RELIABILITY;SAFETY; ZINC-CHLORINE BATTERIES: T2,Q1

B-20

ACCESSION NO. 80C0016419
TITLE REVIEW OF INDUSTRIAL PARTICIPATION IN THE ANL LITHIUM/IRON SULFIDE BATTERY DEVELOPMENT PROGRAM
AUTHORS GAY, E.C.; MILLER, W.E.; MALECHA, R.F.; ELLIOTT, R.C.
AUTHOR AFF ARGONNE NATL LAB, ILL
PUB DESC PROC., INTERSOC. ENERGY CONVERS. ENG. CONF., V. 1, PP. 690-696
SEC REPT NO CONF-780801--P1
CONF TITLE 13. INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE
CONF PLACE SAN DIEGO, CA, USA
CONF DATE 20 AUG 1978
DATE 1978
CATEGORIES EDB-250901
PRIMARY CAT EDB-250901
ABSTRACT LITHIUM/IRON SULFIDE BATTERIES ARE BEING DEVELOPED AT ARGONNE NATIONAL LABORATORY (ANL) FOR USE AS POWER SOURCES FOR ELECTRIC VEHICLES AND FOR STATIONARY ENERGY STORAGE DEVICES FOR LOAD LEVELING. AN IMPORTANT PART OF THE BATTERY PROGRAM INVOLVES SUBCONTRACTS WITH VARIOUS INDUSTRIAL FIRMS. THIS PAPER DESCRIBES THE NATURE OF THE INDUSTRIAL PARTICIPATION IN THE ANL BATTERY PROGRAM AND THE PROGRESS THAT HAS BEEN MADE IN THE DEVELOPMENT AND FABRICATION OF INDUSTRIAL CELLS. IN ORDER TO EVALUATE CELLS FABRICATED BY INDUSTRIAL SUBCONTRACTORS, ANL HAS USED AUTOMATED QUALIFICATION TESTING. PRESENT CELL DEVELOPMENT EFFORTS ARE DIRECTED TOWARD IMPROVING SPECIFIC ENERGY AND POWER IN THE FES CELLS AND IMPROVING CYCLE LIFE AND CURRENT COLLECTOR DESIGN IN FESSUB 2S.
DESCRIPTORS ELECTRIC-POWERED VEHICLES: T3;FABRICATION: Q1;LITHIUM-SULFUR BATTERIES: T1,Q2,Q3;METAL-NONMETAL BATTERIES;OFF-PEAK ENERGY STORAGE: T2;PERFORMANCE TESTING: Q1;RESEARCH PROGRAMS: Q1

B-21

ACCESSION NO. 80C0011287
TITLE CRITICAL REVIEW OF BATTERY CYCLE LIFE TESTING METHODS
AUTHORS MAYER, G.E.
TITLE(MONO) FIFTH INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM
SEC REPT NO CONF-781006--
PAGE NO 1-6, PAPER 783204(E)
CONF TITLE 5. SYMPOSIUM ON ELECTRIC VEHICLE
CONF PLACE PHILADELPHIA, PA, USA
CONF DATE 2 OCT 1978
PUBL LOC ELECTRIC VEHICLE COUNCIL, NEW YORK, NY
DATE 1978
CATEGORIES EDB-330300;250902
PRIMARY CAT EDB-330300
ABSTRACT THE PAPER COMPARES LEAD-ACID BATTERY LABORATORY CYCLE LIFE TESTING METHODS WITH FIELD TESTING OF SIMILAR BATTERIES. FIELD TESTING, ALTHOUGH MORE REALISTIC, TAKES MORE TIME; FURTHER ONLY THE SYSTEM TEST HAS BEEN STANDARDIZED (SAE J227A). NORMAL AND ABNORMAL MODES OF BATTERY FAILURE IN FIELD TESTS ARE DISCUSSED.

	LABORATORY TESTING CAN BE DONE AT A TEMPERATURE AMBIENT, OR HOT OR COLD. COLD TESTING SLOWS DOWN NORMAL PLATE DETERIORATION BUT CAN SHOW UP SHORTCOMINGS IN BATTERY MATERIALS AND ASSEMBLY TECHNOLOGY. HOT TESTING HAS BEEN REPORTED PREVIOUSLY, BUT MODES OF FAILURE MUST BE CORRELATED WITH FIELD FAILURE MODES. AT 70 TO 90SSUP 0SF AMBIENT TEMPERATURES, THE EFFECTS OF CHARGING METHOD ARE CONSIDERED. AT SGL, A TEST SYSTEM IS COMPOSED OF TYPICAL BATTERY-CHARGER COMBINATION, WITH ONLY THE SIMULATION OF THE LOAD. THE EFFECT OF AVERAGE DEPTH OF DISCHARGE ON BATTERY LIFE OF TYPICAL SMALL EV (GOLF CAR) BATTERIES IS DISCUSSED.
DESCRIPTORS	ELECTRIC BATTERIES: Q1;ELECTRIC-POWERED VEHICLES: T1;LEAD-ACID BATTERIES: T2;PERFORMANCE TESTING: Q2;REVIEWS;SERVICE LIFE: Q2

B-22

ACCESSION NO.	80J0010673
TITLE	GAS-TIGHT WITH RECOMBINATION. LEAD BATTERIES WITH GAS COMBINATION OVERCHARGED
AUTHORS	BREUER, B.
AUTHOR AFF	S.A.F.T. G.M.B.H., OFFENBACH AM MAIN (GERMANY, F.R.)
PUB DESC	ELEKTROTECHNIK (WUERZBURG), V. 61, NO. 4, PP. 16-19
DATE	FEB 1979
LANGUAGE	IN GERMAN
CATEGORIES	EDB-250902
PRIMARY CAT	EDB-250902
ABSTRACT	GAS-TIGHT LEAD BATTERIES WERE INTRODUCED FOR THE FIRST TIME IN ELECTRONICS FOR THE CURRENT SUPPLY OF ELECTRONIC EQUIPMENT WHICH WORKS WITH GAS COMBINATION WITH OVERCHARGING. FUNCTIONING AND CHARACTERISTICS OF THIS NEW TYPE OF ACCUMULATOR ARE CONSIDERED IN THIS CONTRIBUTION.
DESCRIPTORS	CAPACITY;GASKETS: Q1;LEAD-ACID BATTERIES: T1;PERFORMANCE; RECOMBINATION: Q1;SERVICE LIFE

B-23

ACCESSION NO.	80R0010669
TITLE(MONO)	STATUS OF THE DOE BATTERY AND ELECTROCHEMICAL TECHNOLOGY PROGRAM
EDITOR OR COMP	ROBERTS, R.
CORPORATE AUTH	MITRE CORP., MCLEAN, VA (USA)
PAGE NO	177
AVAILABILITY	DEP. NTIS, PC A09/MF A01.
CONTRACT NO	CONTRACT ET-78-C-01-3295
DATE	SEP 1979
CATEGORIES	EDB-250901;400400;290700
PRIMARY CAT	EDB-250901
REPORT NO	MTR--8026
ABSTRACT	THIS REPORT REVIEWS THE STATUS OF THE DEPARTMENT OF ENERGY PROGRAM ON ELECTROCHEMICAL STORAGE SYSTEMS AS OF JUNE 1976. IT IS BASED ON MATERIAL PRESENTED AT THE SECOND ANNUAL BATTERY AND ELECTROCHEMICAL TECHNOLOGY CONFERENCE. EMPHASIS IS PLACED ON SECONDARY BATTERIES; HOWEVER, SELECTED MECHANICALLY RECHARGEABLE BATTERIES ARE INCLUDED. BATTERIES IN THE RESEARCH, DEVELOPMENT AND DEMONSTRATION PHASES ARE INCLUDED: NEAR TERM - LEAD-ACID, NICKEL/IRON, NICKEL/ZINC; ADVANCED - LITHIUM/METAL SULFIDE, SODIUM/SULFUR, ZINC/CHLORINE; RESEARCH AND DEVELOPMENT - METAL/AIR, HYDROGEN/CHLORINE, ZINC/BROMINE, REDOX, ORGANIC ELECTROLYTES. SUPPORTING RESEARCH ON THE MORPHOLOGY OF ACTIVE MATERIALS, CELL PERFORMANCE MODELING, NEW BATTERY MATERIALS, AND OTHER TOPICS ARE INCLUDED. STUDIES RELATED TO ENERGY CONSERVATION AND ALTERNATIVE PROCESSES IN ELECTROCHEMICAL INDUSTRY ARE REVIEWED. THE POTENTIAL CONTRIBUTIONS OF THE BATTERY PROGRAM TO THE VARIOUS DOE MISSIONS SUPPORTED - ELECTRIC VEHICLES, PHOTOVOLTAIC SYSTEMS, DISTRIBUTED ELECTRICAL ENERGY SYSTEMS AND ENERGY CONSERVATION IN INDUSTRY - ARE DISCUSSED. 43 FIGURES, 21 TABLES.
DESCRIPTORS	ELECTRIC BATTERIES: T1,D;ELECTRIC-POWERED VEHICLES: ELECTROCHEMISTRY: T2;ENERGY CONSERVATION;EXPERIMENTAL DATA; GRAPHS: D;IRON-NICKEL BATTERIES: D;ISOLATED VALUES: D;LEAD-ACID BATTERIES: D;LITHIUM-SULFUR BATTERIES: D;MATERIALS: D;METAL-GAS BATTERIES: D;NICKEL-ZINC BATTERIES: D;PERFORMANCE: D;REDOX FUEL CELLS: D;RESEARCH PROGRAMS: Q1,Q2,D;SODIUM-SULFUR BATTERIES: D; THEORETICAL DATA;US DOE;ZINC-BROMINE BATTERIES: D;ZINC-CHLORINE BATTERIES: D

B-24

ACCESSION NO.	80J0009696
TITLE	ACCUMULATORS IN SOLAR ELECTRIC PLANTS
AUTHORS	KOETHE, H.K.
AUTHOR AFF	VARTA BATTERIE A.G. (GERMANY, F.R.)
PUB DESC	CHEM. TECH. (BERLIN), V. 8, NO. 4, PP. 143-152
DATE	APR 1979
LANGUAGE	IN GERMAN
CATEGORIES	EDB-140600;140700
PRIMARY CAT	EDB-140600
ABSTRACT	THE STRUCTURAL COMPONENTS OF SOLAR ELECTRIC ENERGY SUPPLIES, THEIR TASKS AND FUNCTIONING ARE DESCRIBED AND A METHOD FOR THE OPTIMUM COSTS AGREEMENT OF THE STRUCTURAL COMPONENTS IN THE SYSTEMS WITH PRESCRIBED PERMANENT POWER IS DESCRIBED. CHARACTERISTIC VALUES AND OPERATIONAL INDICATIONS ARE GIVEN FOR THE MOST IMPORTANT CONSTRUCTION TYPES. A COSTS ANALYSIS SHOW THAT SPECIAL STORAGE MUST BE DEVELOPED FOR SOLAR ELECTRIC PLANTS IN ORDER TO LAY THE PATH FOR THIS TECHNOLOGY IN THE FUTURE.
DESCRIPTORS	COST;DATA;ENERGY STORAGE: Q1;FEASIBILITY STUDIES;LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES;PERFORMANCE;SOLAR CELL ARRAYS;SOLAR CELLS;SOLAR POWER PLANTS: T1;TECHNOLOGY UTILIZATION

B-25

ACCESSION NO. 80R0001165
TITLE(MONO) WETTING BEHAVIOR OF MOLTEN-CHLORIDE ELECTROLYTES: CAPILLARITY EFFECTS IN LITHIUM-ALUMINUM/METAL SULFIDE BATTERIES
EDITOR OR COMP EBERHART, J.G.
CORPORATE AUTH ARGONNE NATIONAL LAB., IL (USA)
PAGE NO 41
AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT W-31-109-ENG-38
DATE AUG 1979
CATEGORIES EDB-250903;400201
PRIMARY CAT EDB-250903
REPORT NO ANL--79-34
ABSTRACT A LITHIUM-ALUMINUM/IRON SULFIDE BATTERY WHICH USES A MOLTEN LICL-KCL ELECTROLYTE IS PRESENTLY UNDER DEVELOPMENT AT ARGONNE NATIONAL LABORATORY. THE PERFORMANCE AND LIFETIME OF THIS ELECTROCHEMICAL SYSTEM DEPEND, IN PART, ON THE ABILITY OF THE ELECTROLYTE TO WET THE MATERIALS USED AS ELECTRODES, SEPARATORS, AND PARTICLE RETAINERS. FOR THIS REASON CONTACT-ANGLE MEASUREMENTS WERE MADE ON SMOOTH, 100%-DENSE SURFACES OF THE CELL MATERIALS. IN ADDITION, ELECTROLYTE PENETRABILITY DETERMINATIONS WERE MADE ON THE POROUS MATERIALS ACTUALLY USED AS CELL SEPARATORS AND PARTICLE RETAINERS. THE RESULTS OF THESE MEASUREMENTS LED TO TECHNIQUES FOR COMPLETELY FILLING POROUS CELL COMPONENTS WITH ELECTROLYTE, SUGGESTIONS FOR DEALING WITH THE PROBLEM OF ELECTROLYTE CREEPING, ESTIMATES OF THE LIKELIHOOD OF ELECTROLYTE TRANSFER FROM ONE POROUS COMPONENT TO ANOTHER, AND ESTIMATION OF THE MAXIMUM ALLOWABLE VERTICAL CELL DIMENSIONS. 15 FIGURES, 1 TABLE.
DESCRIPTORS ALUMINIUM: T14,D;ALUMINIUM ALLOYS: T4,D;ALUMINIUM OXIDES: T9,D; BATTERY SEPARATORS;BINARY ALLOY SYSTEMS;BORON NITRIDES: T8,D; CAPILLARY FLOW;CARBON: T10,D;CREEP;DIFFUSION;DIMENSIONS; ELECTRIC-POWERED VEHICLES: T1;ELECTROLYTES: Q3,D;EXPERIMENTAL DATA: D;GRAPHS: D;HIGH TEMPERATURE: D;IRON: T15,D;IRON SULFIDES: T6,D;LITHIUM ALLOYS: T5,D;LITHIUM CHLORIDES;LITHIUM SULFIDES: T16,D;LITHIUM-SULFUR BATTERIES: T3,Q1,Q2,D;MAGNESIUM OXIDES: T7,D;MATERIALS;OFF-PEAK ENERGY STORAGE: T2;PERMEABILITY; POTASSIUM CHLORIDES;STAINLESS STEEL-304: T13,D;WETTABILITY: Q4,Q5,Q6,Q7,Q8,Q9,Q10,Q11,Q12,Q13,Q14,Q15,Q16,D;YTTRIUM OXIDES: T12,D;ZIRCONIUM OXIDES: T11,D

B-26

ACCESSION NO. 79R0136614
TITLE(MONO) SODIUM-SULFUR BATTERY SUPPORTING R AND D: AN EVALUATION OF AN ALTERNATIVE ELECTROLYTE AND BATTERY PRICE. FINAL REPORT, JANUARY 1977-JUNE 1978
EDITOR OR COMP WICKER, A.; HONPON, J.P.
CORPORATE AUTH COMPAGNIE GENERALE D'ELECTRICITE (CGE), 91 - MARCOUSSIS (FRANCE)
PAGE NO 140
AVAILABILITY DEP. NTIS, PC A07/MF A01.
DATE JUL 1979
CATEGORIES EDB-250901;250903
PRIMARY CAT EDB-250901
REPORT NO EPRI-EM--1116
ABSTRACT THIS PROJECT HAS THE BROAD OBJECTIVES OF DEVELOPING MATERIALS AND ASSESSING COSTS OF THE SODIUM-SULFUR BATTERY. DURING THIS PHASE OF THE PROJECT COSTS OF TWO CELL DESIGN ALTERNATIVES WERE COMPARED, A NEW ELECTROLYTE WAS INVESTIGATED, AND ELECTROLYTE TUBES WERE FABICATED AND DELIVERED TO EPRI. THE FABICATING OF ELECTROLYTE TUBES IS NOT COVERED IN THE REPORT. THE FIRST MAJOR OBJECTIVE OF THIS STUDY WAS TO EVALUATE PERFORMANCE AND COST OF SODIUM-SULFUR CELLS. THESE CELLS USE A BETA ALUMINA ELECTROLYTE TUBE TO SEPARATE THE ACTIVE MATERIALS, SODIUM AND SULFUR. IN ONE DESIGN APPROACH SULFUR IS CONTAINED INSIDE THE ELECTROLYTE TUBE AND SODIUM SURROUNDS THE TUBE. IN THE OTHER APPROACH THE LOCATION OF SULFUR AND SODIUM ARE REVERSED. THE STUDY EVALUATES THE FORMER APPROACH AND COMPARES THE RESULTS WITH AN EARLIER STUDY (RP726-1) IN WHICH THE LATTER APPROACH IS EVALUATED. CELLS, MODULES, AND UNITS FOR A 100 MWH LOAD-LEVELING BATTERY WERE DESIGNED AND COSTS WERE ESTIMATED ON THE BASIS OF PRODUCTION OF 25 UNITS/YEAR. PARTICULAR ATTENTION WAS PAID TO RELIABILITY, SAFETY, AND HEAT TRANSFER AND RECOVERY. EFFICIENCY WILL BE A MINIMUM OF 75.2%. INSTALLED COST WILL BE $53 (1976) /KWH, AS COMPARED WITH $41 (1976)/KWH THE SULFUR OUTSIDE CONFIGURATION CASE. THE SECOND MAJOR OBJECTIVE WAS TO EVALUATE THE FABRICATION PROCESS AND PROPERTIES OF THE NEW SOLID ELECTROLYTE NA$SUB 3$ZR$SUB 2$SI$SUB 2$PO$SUB 12$ (NASICON). HELIUM LEAK-TIGHT TUBES WITH A RESISTIVITY OF ABOUT 5 $OMEGA$ CM AT 300$SUP 0$C WERE MADE. SINTERING OCCURS AT 1280$SUP 0$C, WITHOUT ANY BUFFERING ATMOSPHERE. A PHASE TRANSFORMATION, AT 280$SUP 0$C, DID NOT ALLOW THE MANUFACTURING OF AN ELECTROCHEMICAL CELL THAT COULD STAND THERMAL SHOCKS. THE HIGH COST OF RAW MATERIALS SEEMED TO CANCEL THE BENEFIT OF LOW-COST SINTERING. 47 FIGURES, 17 TABLES.
DESCRIPTORS ALUMINIUM OXIDES;COST: Q1,D;DESIGN: Q1;EFFICIENCY: D; ELECTROLYTES: Q1,D;EVALUATION;GRAPHS: D;MATERIALS;OFF-PEAK ENERGY STORAGE: T2;PERFORMANCE: D;PLANNING;RESEARCH PROGRAMS; SINTERING;SODIUM OXIDES;SODIUM-SULFUR BATTERIES: T1,Q2,D; TABLES: D;THEORETICAL DATA: D

B-27

ACCESSION NO. 79C0136017
REPORT NO,PAGE CONF-790595 PP. 6.53-6.61
TITLE STATUS REPORT ON 25 KW PHOTOVOLTAIC POWER GENERATION EXPERIMENT AT MEAD, NEBRASKA
AUTHORS FORMAN, S.E.
AUTHOR AFF MASSACHUSETTS INST. OF TECH., LEXINGTON
TITLE(MONO) PROCEEDINGS OF THE US DOE PHOTOVOLTAICS TECHNOLOGY DEVELOPMENT AND APPLICATIONS PROGRAM REVIEW
PAGE NO 6.53-6.61
AVAILABILITY DEP. NTIS, PC A24/MF A01.
CONF TITLE DOE SEMI-ANNUAL REVIEW FOR PHOTOVOLTAICS
CONF PLACE GATLINBURG, TN, USA
CONF DATE 16 MAY 1979
DATE 1979
CATEGORIES EDB-140501
PRIMARY CAT EDB-140501
REPORT NO CONF-790595--
ABSTRACT NONE

FROM STORAGE; DIRECT HEATING AND STORAGE SIMULTANEOUSLY; AUXILIARY HEATING (INSUFFICIENT SOLAR); RANKINE COOLING FROM COLLECTORS; RANKINE COOLING FROM STORAGE; RANKINE COOLING AND STORAGE SIMULTANEOUSLY; ELECTRIC MOTOR AUXILIARY COOLING; DOMESTIC HOT-WATER PREHEATER; AND PURGE EXCESS ENERGY (FIRST STAGE LAUNDRY, SECOND STAGE FAN COIL). OPERATION AND PERFORMANCE OF THE SYSTEM ARE DISCUSSED.

DESCRIPTORS: APARTMENT BUILDINGS: T1;DATA ACQUISITION;FLAT PLATE COLLECTORS; HEAT PUMPS;HEAT STORAGE;KANSAS;OPERATION;PERFORMANCE: Q2,Q3,Q4; RANKINE CYCLE ENGINES: Q2;SIZE;SOLAR AIR CONDITIONERS: T2;SOLAR AIR CONDITIONING: Q1;SOLAR HEAT ENGINES;SOLAR HEATING SYSTEMS: T3;SOLAR SPACE HEATING: Q1;SOLAR WATER HEATERS: T4;SOLAR WATER HEATING: Q1;SOLAR-ASSISTED HEAT PUMPS;TANKS

B-28

ACCESSION NO. 79J0118368
TITLE: LIFE TESTING OF LEAD ACID BATTERIES FOR ELECTRIC VEHICLE DUTIES
AUTHORS: PONSFORD, J.M.
AUTHOR AFF: LUCAS BATTERIES LTD, ENGL
PUB DESC: SAE PREPR., NO. 790157, PP. 1-6
DATE: 1979
CATEGORIES: EDB-330300;250902;250904
PRIMARY CAT: EDB-330300
ABSTRACT: THE LEAD-ACID COUPLE IS POTENTIALLY CAPABLE OF FULFILLING THE BATTERY REQUIREMENT FOR HIGH PERFORMANCE ELECTRIC DELIVERY VEHICLES IN THE ONE TON PAYLOAD CATEGORY. DEVELOPMENT OF SUCH A BATTERY, COMBINING HIGH ENERGY DENSITY AND GOOD CYCLE LIFE, INVOLVES EXTENSIVE AND PAINSTAKING TESTING. DURING THE COURSE OF THE LUCAS DEVELOPMENT PROGRAM TEST METHODS AND PROCEDURES HAVE BEEN EVOLVED TO ENSURE THAT THE BATTERY ARRAY WITH ITS SUPPORTING EQUIPMENT IS CAPABLE OF FULLY PERFORMING THE TASKS REQUIRED OF IT IN SUCH AN APPLICATION. MUCH OF THE EXPERIENCE GAINED IS APPLICABLE TO ANY ELECTROCHEMICAL COUPLE BEING DEVELOPED FOR ELECTRIC VEHICLE USE. 2 REFS.
DESCRIPTORS: ELECTRIC-POWERED VEHICLES: T1;LEAD-ACID BATTERIES: T2,Q1; SERVICE LIFE;TESTING: Q2

B-29

ACCESSION NO. 79R0117598
TITLE(MONO): HIGH-PERFORMANCE BATTERIES FOR ELECTRIC-VEHICLE PROPULSION AND STATIONARY ENERGY STORAGE. PROGRESS REPORT, OCTOBER 1976-MARCH 1979
CORPORATE AUTH: ARGONNE NATIONAL LAB., IL (USA)
PAGE NO: 151
AVAILABILITY: DEP. NTIS, PC A06/MF A01.
CONTRACT NO: CONTRACT W-31-109-ENG-38
DATE: MAY 1979
CATEGORIES: EDB-250901;330300;200107
PRIMARY CAT: EDB-250901
AUGMENTATION: CA/SULFIDES
REPORT NO: ANL--79-39
ABSTRACT: THIS REPORT COVERS THE RESEARCH, DEVELOPMENT, AND MANAGEMENT ACTIVITIES OF THE PROGRAMS AT ARGONNE NATIONAL LABORATORY (ANL) AND AT SUBCONTRACTORS' LABORATORIES ON HIGH-TEMPERATURE BATTERIES DURING THE PERIOD OCTOBER 1976 TO MARCH 1979. THESE BATTERIES ARE BEING DEVELOPED FOR ELECTRIC-VEHICLE PROPULSION AND FOR STATIONARY ENERGY-STORAGE APPLICATIONS. THE PRESENT CELLS, WHICH OPERATE AT 400 TO 500$SUP 0$C, ARE OF A VERTICALLY ORIENTED, PRISMATIC DESIGN WITH ONE OR MORE INNER POSITIVE ELECTRODES OF FES OR FES$SUB 2$, FACING ELECTRODES OF LITHIUM-ALUMINUM ALLOY, AND MOLTEN LICL-KCL ELECTROLYTE. DURING THIS SIX-MONTH PERIOD, CELL AND BATTERY DEVELOPMENT WORK CONTINUED AT ANL, EAGLE-PICHER INDUSTRIES, INC., GOULD INC., AND THE ENERGY SYSTEMS GROUP OF ROCKWELL INTERNATIONAL. FABRICATION OF A 40-KWH BATTERY BY EAGLE-PICHER FOR TESTING IN AN ELECTRIC VAN IS NEARING COMPLETION. COST AND DESIGN STUDIES FOR A MARK II ELECTRIC-VEHICLE BATTERY, WHICH WILL HAVE SOMEWHAT HIGHER PERFORMANCE AND USE POTENTIALLY LOW-COST MATERIALS AND FABRICATION METHODS, WERE CONDUCTED BY ALL THREE SUBCONTRACTORS, AND CONTRACTS ARE BEING NEGOTIATED FOR DEVELOPMENT OF MARK II BATTERIES. CONCEPTUAL DESIGN STUDIES CONTINUED AT ROCKWELL INTERNATIONAL ON A 100 MWH STATIONARY ENERGY-STORAGE MODULE. THE PRESENT PLAN IS TO CONSTRUCT A MODULE BASED ON THESE DESIGNS FOR TESTING AT THE BEST (BATTERY ENERGY STORAGE TEST) FACILITY. WORK WAS ALSO IN PROGRESS AT THE CARBORUNDUM CO., GENERAL MOTORS RESEARCH LABORATORIES, AND VARIOUS OTHER ORGANIZATIONS ON DEVELOPING MATERIALS AND COMPONENTS FOR CELLS. 38 FIGURES, 28 TABLES.
DESCRIPTORS: ALUMINIUM ALLOYS;BINARY ALLOY SYSTEMS;CALCIUM;COST: D;DESIGN; ELECTRIC-POWERED VEHICLES: T1;EXPERIMENTAL DATA: D;HIGH TEMPERATURE;IRON SULFIDES;ISOLATED VALUES: D;LITHIUM ALLOYS; LITHIUM CHLORIDES;LITHIUM-SULFUR BATTERIES: Q1,Q2,T3,D; MATERIALS: D;METAL-NONMETAL BATTERIES: M4,D;OFF-PEAK ENERGY STORAGE: T2;PERFORMANCE: D;PLANNING;POTASSIUM CHLORIDES;PYRITE; RESEARCH PROGRAMS: Q3,D,Q4;SULFIDES;TESTING

B-30

ACCESSION NO.	79C0103911
TITLE	LEAD-ACID BATTERIES FOR REMOTE PHOTOVOLTAIC APPLICATIONS.
AUTHORS	SCHAETZLE, H.J.; BODEN, D.P.
AUTHOR AFF	ELTRA CO. C AND D BATTERIES DIV. PLYMOUTH MEETING, PA
TITLE(MONO)	INTERNATIONAL TELEPHONE ENERGY CONFERENCE
SEC REPT NO	CONF-7810103--
PAGE NO	244-246
CONF TITLE	INTERNATIONAL TELEPHONE ENERGY CONFERENCE
CONF PLACE	WASHINGTON, DC, USA
CONF DATE	25 OCT 1978
PUBL LOC	NEW YORK, NY, INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
DATE	1978
CATEGORIES	EDB-140501;250902
PRIMARY CAT	EDB-140501
ABSTRACT	THE VARIOUS LOAD PROFILE CHARACTERISTICS MOST COMMONLY ENCOUNTERED IN PHOTOVOLTAIC INSTALLATIONS ARE ANALYZED IN CONJUNCTION WITH SOLAR ARRAY AND BATTERY PERFORMANCE DATA AND USED TO GENERATE BATTERY SPECIFICATIONS WITH RESPECT TO OPERATING CHARACTERISTICS AND CYCLE LIFE REQUIREMENTS. THE DESIGN OF LEAD-ACID BATTERIES FOR PHOTOVOLTAIC APPLICATIONS IS DISCUSSED AND ILLUSTRATED WITH OPERATING, MAINTENANCE, AND CYCLE LIFE DATA. OTHER PERFORMANCE CHARACTERISTICS OF LEAD-ACID PHOTOVOLTAIC BATTERIES ARE DESCRIBED INCLUDING THE EFFECTS OF OPERATING TEMPERATURE AND THE CORRECT CHOICE OF CHARGING METHOD FOR VARIOUS OPERATIONAL REQUIREMENTS.
DESCRIPTORS	BATTERY CHARGING;COST;DESIGN;ENERGY STORAGE: Q1;LEAD-ACID BATTERIES: T2;MAINTENANCE;OPERATION;PERFORMANCE: Q2;SOLAR CELL ARRAYS: T1;SPECIFICATIONS: Q1;TEMPERATURE EFFECTS

B-31

ACCESSION NO.	79J0094466
TITLE	WHEN FUEL RUNS OUT, ELECTRICS OVERTAKE
AUTHORS	KERR, J.
PUB DESC	ENGINEER (LONDON), V. 247, NO. 6395, PP. 22-23, 26, 29
DATE	19 OCT 1978
CATEGORIES	EDB-330300;290700
PRIMARY CAT	EDB-330300
ABSTRACT	THE ELECTRIC MOTOR (A PROVEN FORM OF TRACTION) WILL TAKE OVER WHEN THERE IS NO MORE FUEL FOR THE INTERNAL-COMBUSTION ENGINE (ICE). AT A TRANSPORT AND ROAD RESEARCH LABORATORY CONFERENCE, COAL-TO-OIL CONVERSION AND ELECTRIC VEHICLES WERE NOMINATED AS THE BEST WAYS TO FACE TH WORSENING FUEL SHORTAGES. BRITAIN IS GENERALLY CONSIDERED TO DOMINATE THE WORLD'S ELECTRIC VEHICLE INDUSTRY. LUCAS AND CHLORIDE SPEARHEAD BRITISH PROJECTS TO PRODUCE A COMMERCIALLY VIABLE ELECTRIC VEHICLE WHICH IS ALSO TRAFFIC COMPATIBLE. EXPERIMENTS AT LUCAS ON BUSES, TAXIS, MINIBUSES, AND VANS ARE BRIEFLY DESCRIBED. THE COMPANY IS NOW CONCENTRATING ON VANS. CHLORIDE IS ADHERELY TO DEVELOPMENT OF A COMMERCIAL LINE, AND HAS EQUIPPED THE EXPERIMENTAL SILENT RIDER 50-PASSENGER BUS. THE DODGE SILENT KARRIER IS THE RESULT OF COOPERATION BETWEEN NATIONAL FREIGHT CORPORATION, CHLORIDE, AND CHRYSLER. PROGRESS BEING MADE ON ELECTRIC VEHICLE DEVELOPMENT IN THE UNITED STATES, JAPAN, FRANCE, AND GERMANY IS REVIEWED. BRITISH COMPANIES AND USERS HAVE SHUNNED THE HYBRID ELECTRIC VEHICLE BECAUSE OF ITS COMPLEXITY. THOSE USING SOME FORM OF ENERGY RECUPERATION SUCH AS A FLYWHEEL OR PNEUMATIC ACCUMULATOR POSE INVOLVED CONTROL AND TRANSMISSION PROBLEMS. OTHER TYPES WITH AN ICE FOR BATTERY CHARGING OR TRACTIVE POWER RE-INTRODUCE NOISE AND POLLUTION DIFFICULTIES. ELECTRIC VEHICLES ARE RECOGNIZED TO OFFER NOISE- AND POLLUTION-FREE OPERATION TOGETHER WITH RELIABILITY, SIMPLICITY, AND LOW-MAINTENANCE COSTS. IN BRITAIN, CHLORIDE IS BEGINNING A TEST PROGRAM FOR THE SODIUM--SULFUR BATTERY; THIS BATTERY OFFERS A GREATER RANGE, MAKING IT USEFUL FOR INTER-CITY TRAVEL. (MCW)
DESCRIPTORS	BUSES;ECONOMICS;ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES: T1,Q2;ENVIRONMENTAL POLICY;EUROPE;EVALUATION;FORECASTING; INTERNAL COMBUSTION ENGINES;IRON-NICKEL BATTERIES;JAPAN; NICKEL-ZINC BATTERIES;RESEARCH PROGRAMS: Q1;REVIEWS;SAFETY; SODIUM-SULFUR BATTERIES;STANDARD OF LIVING;TESTING;UNITED KINGDOM: T2;USA;USES: Q1

0.75 V; (III) NO NEED TO RECYCLE THE CO$SUB 2$ STREAM FROM ANODE TO CATHODE; (IV) NO CELL CORROSION PROBLEMS; AND (V) STABLE ELECTROLYTES. BROWN, BOVERI AND CIE HAVE RUN A SINGLE CELL FOR OVER 40,000 HOURS AND A MULTI-CELL STACK FOR OVER 10,000 HOURS. A WESTINGHOUSE MULTI-CELL STACK (5 CELLS) WAS DESIGNED, FABRICATED AND TESTED FOR OVER 700 HOURS. THE OPERATING CELL CHARACTERISTICS (200 MA CM$SUP -2$ AT 0.7 VOLTS) ARE ENCOURAGING IN RESPECT TO MEETING POWER PLANT PERFORMANCE GOALS. SOLID ELECTROLYTE FUEL CELL POWER PLANTS APPEAR PROMISING FOR LARGE SCALE POWER GENERATION AFTER THE YEAR 2000.

DESCRIPTORS — COAL FUEL CELLS: T2;COAL GASIFICATION;COMPARATIVE EVALUATIONS; CORROSION;CURRENT DENSITY;EFFICIENCY;ELECTROLYTES;FUEL CELL POWER PLANTS: T;HIGH-TEMPERATURE FUEL CELLS: T1;IONIC CONDUCTIVITY;OPERATION;PERFORMANCE: Q1,Q2;REVIEWS;SOLID ELECTROLYTES

B-32

ACCESSION NO.	79R0086050
TITLE(MONO)	DEVELOPMENT AND EVALUATION OF MATERIALS FOR HIGH TEMPERATURE LITHIUM/SULFUR RECHARGEABLE BATTERIES
EDITOR OR COMP	SWAROOP, R.B.; SMAGA, J.A.; BATTLES, J.E.
CORPORATE AUTH	ARGONNE NATIONAL LAB., IL (USA)
PAGE NO	29
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
DATE	MAR 1979
CATEGORIES	EDB-250903;250902
PRIMARY CAT	EDB-250903
REPORT NO	DOE/TIC--10098
ABSTRACT	ELECTROCHEMICAL ENERGY STORAGE IS BEING ACHIEVED BY THE DEVELOPMENT OF HIGH-TEMPERATURE RECHARGEABLE BATTERIES. LI--AL/FES SECONDARY BATTERIES ARE BEING DEVELOPED FOR USE OF POWER SOURCES FOR ELECTRICAL VEHICLES AND AS STATIONARY ENERGY STORAGE DEVICES FOR LOAD-LEVELING ON ELECTRIC UTILITIES. THIS BATTERY COULD BE RECHARGED BY THE ELECTRICITY PRODUCED VIA PHOTOVOLTAIC SOLAR ENERGY, NUCLEAR ENERGY, OR COAL-STEAM TURBINES. THE HIGH TEMPERATURE CORROSIVENESS OF THE ACTIVE MATERIALS AND MOLTEN ELECTROLYTE PLACES SEVERE RESTRICTION ON THE TYPE OF MATERIALS THAT CAN BE USED FOR CURRENT COLLECTORS, SEPARATORS, AND FEEDTHROUGH INSULATORS. OUT-OF-CELL AND IN-CELL TESTS ARE BEING CONDUCTED TO IDENTIFY THE MATERIALS THAT ARE COMPATIBLE WITH THIS CELL ENVIRONMENT. THE CORROSION TEST PROCEDURES, THE NATURE AND KINETICS OF THE CORROSION REACTIONS, AND THE DEVELOPMENT AND TESTING OF ELECTRODE SEPARATORS ARE DISCUSSED.
DESCRIPTORS	BATTERY SEPARATORS: T4;CERAMICS: T2;COMPATIBILITY;CORROSION: Q1; ELECTRIC-POWERED VEHICLES: T6;LITHIUM-SULFUR BATTERIES: T1,Q5,Q6;MATERIALS: Q1;MATERIALS TESTING: Q2,Q3;METALS: T3; OFF-PEAK ENERGY STORAGE: T5;PERFORMANCE TESTING: Q4

B-33

ACCESSION NO.	79C0088049
TITLE(MONO)	DEVELOPMENT OF POROUS SINTERED-CERAMIC SEPARATORS FOR APPLICATION IN A LI--AL/LICL--KCL/FES BATTERY
EDITOR OR COMP	BANDYOPADHYAY, G.; DUSEK, J.T.; GALVIN, T.M.
CORPORATE AUTH	ARGONNE NATIONAL LAB., IL (USA)
PAGE NO	17
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
CONF TITLE	4. INTERNATIONAL MEETING ON MODERN CERAMIC TECHNOLOGIES
CONF PLACE	ST VINCENT, ITALY
CONF DATE	26 MAY 1979
DATE	1979
CATEGORIES	EDB-250903
PRIMARY CAT	EDB-250903
AUGMENTATION	MGO AND Y$SUB 2$O$SUB 3$ EVALUATION
REPORT NO	CONF-790526--2
ABSTRACT	THE PROCEDURE FOR FABRICATION OF POROUS SINTERED-CERAMIC SEPARATORS AND THE TECHNICAL FEASIBILITY OF USING SUCH SEPARATORS IN LI--AL/MOLTEN LICL--KCL/FES BATTERY CELLS WERE INVESTIGATED. PROCESSING TECHNIQUES WERE DEVELOPED TO FABRICATE APPROX. 1.5 TO 2.5 MM THICK, APPROX. 35 TO 60% POROUS, FLAT, SINTERED Y$SUB 2$O$SUB 3$ AND MGO SEPARATOR PLATES WITH SUFFICIENT STRENGTH TO ALLOW HANDLING PRIOR TO AND DURING CELL

ASSEMBLY. THESE SEPERATORS PERFORMED SUCCESSFULLY IN LABORATORY-SCALE CELLS FOR UP TO APPROX. 2000 H AND 283 CYCLES; THUS THE CONCEPT OF A SINTERED SEPARATOR IS VIABLE FOR LI--AL/FES BATTERIES. THE PARTICULARLY ATTRACTIVE FEATURES OF THESE SEPARATORS ARE POTENTIALLY LOW COST, PREFABRICATED FORM THAT ALLOWS EASY CELL ASSEMBLY, AND SMALL PORE SIZE (AVERAGE DIAMETER 0.5 TO 1.0 MUM), WHICH PROVIDES GOOD PARTICLE RETENTION. THE TEST RESULTS FROM THE SINTERED-SEPARATOR CELLS INDICATE THAT Y$SUB 2$O$SUB 3$ IS PROBABLY UNSUITABLE FOR LONG-TERM PERFORMANCE IN LI--AL/FES CELLS BECAUSE OF ITS REACTION WITH THE POSITIVE ACTIVE MATERIAL. THIS IS IN AGREEMENT WITH THE RECENTLY REPORTED DATA ON CELLS WITH Y$SUB 2$O$SUB 3$ FELT AND POWDER SEPARATORS. SINTERED MGO SEPARATORS, HOWEVER, SHOWED GOOD CHEMICAL AND MECHANICAL STABILITY IN THE CELL ENVIRONMENT. 9 FIGURES, 1 TABLE.

DESCRIPTORS: BATTERY SEPARATORS: Q1;CERAMICS;ELECTRIC-POWERED VEHICLES: T3; EVALUATION;FABRICATION;FEASIBILITY STUDIES;IRON SULFIDES; LITHIUM ALLOYS;LITHIUM CHLORIDES;LITHIUM-SULFUR BATTERIES: M1,Q2,Q3;MAGNESIUM OXIDES;OFF-PEAK ENERGY STORAGE: T2; PERFORMANCE TESTING;PLATES;POROUS MATERIALS;POTASSIUM CHLORIDES; SINTERED MATERIALS;YTTRIUM OXIDES

B-34

ACCESSION NO.: 79R0068044
TITLE(MONO): ENGINEERING DEVELOPMENT OF LITHIUM/METAL SULFIDE BATTERY TECHNOLOGY FOR VEHICLE PROPULSION. SUMMARY REPORT, OCTOBER 1977--SEPTEMBER 1978
EDITOR OR COMP: BARNEY, D.L.; CHILENSKAS, A.A.; DELUCA, W.H.; HAYES, E.R.; HORNSTRA, F.; FARAHAT, M.K.; GRAAE, J.A.E.; BOX, S.
CORPORATE AUTH: ARGONNE NATIONAL LAB., IL (USA)
PAGE NO: 35
AVAILABILITY: DEP. NTIS, PC A03/MF A01.
CONTRACT NO: CONTRACT W-31-109-ENG-38
DATE: MAR 1979
CATEGORIES: EDB-250901
PRIMARY CAT: EDB-250901
AUGMENTATION: 40 KWH
REPORT NO: ANL--79-1
ABSTRACT: THE RESEARCH, DEVELOPMENT, AND MANAGEMENT ACTIVITIES DONE IN PREPARATION FOR IN-VEHICLE TESTING OF ENGINEERING-SCALE LITHIUM/METAL SULFIDE BATTERIES ARE DESCRIBED. THESE ACTIVITIES WERE CARRIED OUT AT ARGONNE NATIONAL LABORATORY (ANL) FROM OCTOBER 1977 TO SEPTEMBER 1978. OVER THE PAST YEAR, LEAD--ACID BATTERIES WERE TESTED BOTH IN THE LABORATORY AND IN A RENAULT AUTOMOBILE. THE DATA OBTAINED FROM THESE TESTS WILL BE USED TO ASSESS THE PERFORMANCE OF LITHIUM/METAL SULFIDE BATTERIES. TESTING OF A 40 KWH LITHIUM/METAL SULFIDE BATTERY IN A VEHICLE IS PLANNED FOR EARLY 1979. THE EQUIPMENT NEEDED TO EVALUATE THE PERFORMANCE OF THIS BATTERY WAS DESIGNED AND FABRICATED. TESTING OF THIS EQUIPMENT IS EXPECTED TO BEGIN AT THE END OF 1978. IN ORDER TO CARRY OUT THE ABOVE IN-VEHICLE TEST, THE LITHIUM/METAL SULFIDE BATTERY MUST HAVE A THERMALLY EFFICIENT CASE AND A CHARGER. CONSTRUCTION OF SUCH A CASE IS IN PROGRESS. A PORTABLE CHARGER/EQUALIZER THAT HAS THE CAPABILITY OF CHARGING UP TO SIX LITHIUM/METAL SULFIDE CELLS WAS FABRICATED. 12 FIGURES, 8 TABLES.
DESCRIPTORS: BATTERY CHARGERS;CONTAINERS;COST;ELECTRIC-POWERED VEHICLES: T2; EXPERIMENTAL DATA: D;ISOLATED VALUES: D;LEAD-ACID BATTERIES: T3,D;LITHIUM-SULFUR BATTERIES: M1,Q2;MECHANICAL TESTS: D; OFF-PEAK ENERGY STORAGE;PERFORMANCE TESTING: Q3,D;RESEARCH PROGRAMS: Q1;SULFIDES

B-35

ACCESSION NO.: 79J0082298
TITLE: BATTERIES MOVE UP THE POWER LADDER
AUTHORS: FLYNN, G.
PUB DESC: PROD. ENG. (N.Y.), V. 49, NO. 9, PP. 81-84
DATE: SEP 1978
CATEGORIES: EDB-250904;330300
PRIMARY CAT: EDB-250904
ABSTRACT: CURRENT DEVELOPMENTS IN PRIMARY AND SECONDARY BATTERIES ARE HIGHLIGHTED. AT THE LOW-POWER END OF BATTERY USAGE, NICKEL-CADMIUM BATTERIES ARE COMPETING WITH LEAD-ACID AND LITHIUM BATTERIES. IN THE CASE OF HIGH-POWER BATTERIES, THE

LEAD-ACID BATTERY IS COMPETING WITH ALL THE NEWCOMERS. ADVANCES IN THE BATTERIES FOR ELECTRIC VEHICLES ARE ALSO DISCUSSED. GENERAL MOTORS IS EXPERIMENTING WITH A ZINC-NICKEL-OXIDE BATTERY, WHICH IN ITS PRESENT STATE HAS A SPECIFIC ENERGY OF ABOUT 70 W-HR/KG, PERMITTING THE 160-KM RANGE ELECTRIC CAR APPLICATION.

DESCRIPTORS: ELECTRIC BATTERIES: T2,Q1;ELECTRIC-POWERED VEHICLES: T1; LEAD-ACID BATTERIES;REVIEWS: Q2

B-36

ACCESSION NO.: 79J0082282
TITLE: SODIUM/SULPHUR BATTERY. A NEW HIGH-POWER ACCUMULATOR
AUTHORS: FISCHER, W.); HAAR, W.
AUTHOR AFF: BROWN, BOVERI UND CIE A.G., HEIDELBERG (GERMANY, F.R.);(BROWN, BOVERI UND CIE A.G., HEIDELBERG (GERMANY, F.R.). ZENTRALES FORSCHUNGSLABOR
PUB DESC: PHYS. UNSERER ZEIT, V. 9, NO. 6, PP. 164-191
DATE: NOV 1976
LANGUAGE: IN GERMAN
CATEGORIES: EDB-250902
PRIMARY CAT: EDB-250902
ABSTRACT: AFTER COMPARING SOME OF THE PROPERTIES OF SECONDARY BATTERIES NOW IN DEVELOPMENT, THE STATE OF THE ART OF THE NA/S BATTERY IS DICUSSED. THE PAPER DEALS WITH THE SOLID ELECTROLYTE, THE SULPHUR ELECTRODE, CORROSION PROBLEMS, THEIR TIME BEHAVIOUR, THEIR CAPACITY AND THEIR POWER DENSITY. POSSIBLE APPLICATIONS ARE IN ELECTRIC ROAD VEHICLES AND IN LOAD PEAK SHAVING.
DESCRIPTORS: CAPACITY;COMPARATIVE EVALUATIONS;DESIGN;ELECTRIC BATTERIES; PERFORMANCE: Q1;SERVICE LIFE;SODIUM-SULFUR BATTERIES: T1;USES

B-37

ACCESSION NO.: 79R0062273
TITLE(MONO): DEVELOPMENT OF THE ZINC--CHLORINE BATTERY FOR UTILITY APPLICATIONS. INTERIM REPORT, JANUARY 1, 1977--MARCH 31, 1978
EDITOR OR COMP: BIRK, J.
CORPORATE AUTH: ENERGY DEVELOPMENT ASSOCIATES, MADISON HEIGHTS, MI (USA)
PAGE NO: 310
AVAILABILITY: DEP. NTIS, PC A14/MF A01.
DATE: APR 1979
CATEGORIES: EDB-250901;250904
PRIMARY CAT: EDB-250901
AUGMENTATION: 100-MWH PLANT WITH 45-KWH MODULES
REPORT NO: EPRI-EM--1051(PT.4)(APP.)
ABSTRACT: THE ZINC--CHLORINE BATTERY SYSTEM IS PRESENTLY UNDER DEVELOPMENT AS A PEAK-SHAVING ENERGY-STORAGE DEVICE FOR THE ELECTRIC UTILITY INDUSTRY. THE PRINCIPAL THRUSTS OF THE PRESENT PROGRAM WERE PREPARATION AND ANALYSIS OF A NEW 100-MWH PLANT DESIGN; AND DESIGN, FABRICATION, AND INITIAL TESTING OF A 45-KWH BATTERY MODULE - THE BASIC UNIT OF THE NEW 100-MWH PLANT DESIGN. DEVELOPMENT PROGRAMS ON ELECTRODE RESEARCH, ELECTROLYTE OPTIMIZATION, CELL DESIGN, BATTERY-PERFORMANCE VERIFICATION, AND LOW-COST MATERIALS AND PROCESSES WERE CONDUCTED IN SUPPORT OF THESE OBJECTIVES. A NEW CONCEPTUAL DESIGN OF 100-MWH BATTERY PLANT IS BASED ON THE CONCEPT OF FULLY INTEGRATED ZINC--CHLORINE HYDRATE BATTERY MODULES. THE BATTERY PLANT COMPRISES THIRTY-SIX INDEPENDENT STRINGS, EACH STRING CONSISTING OF 44 SERIES-CONNECTED 66-KWH BATTERY MODULES. A CONCEPTUAL MANUFACTURING PLAN FOR A PRODUCTION RATE OF 100 BATTERY MODULES PER DAY WAS PREPARED. THE INSTALLED COST OF THE 100-MWH BATTERY PLANT WAS ESTIMATED TO BE $26/KWH PLUS $91/KW (1977 $). THE SAFETY, ENVIRONMENTAL, AND LEGAL ASPECTS OF SITING 100-MWH ZINC--CHLORINE BATTERY PLANTS AT SUBSTATIONS IN RESIDENTIAL AREAS WERE ALSO ANALYZED. THE DESIGN IS JUDGED TO BE OPTIMAL IN THE AREAS OF PERFORMANCE, SAFETY, AND MANUFACTURABILITY, WHILE COMPARING FAVORABLY IN COST AND RELIABILITY TO EARLIER DESIGNS. THE MODULE PROTOTYPE WAS DESIGNED, FABRICATED, ASSEMBLED, AND TESTED. THE 45-KWH MODULE, WHICH PERFORMED WELL AS A SYSTEM, DELIVERED IN EXCESS OF THE DESIGN LEVEL FOR DC ENERGY OUTPUT. HOWEVER, THE EFFICIENCY, AT 50%, WAS LOWER THAN THE DESIGN TARGET. THE SIGNIFICANT ACCOMPLISHMENTS IN THE DEVELOPMENT PROGRAM ARE SET FORTH. 144 FIGURES, 54 TABLES.
DESCRIPTORS: ELECTRIC UTILITIES;ELECTRODES;ELECTROLYTES;GRAPHS: D;MATERIALS; OFF-PEAK ENERGY STORAGE: M1;PERFORMANCE TESTING;RESEARCH

PROGRAMS: Q2.D;THEORETICAL DATA: D;ZINC-CHLORINE BATTERIES: Q1.M2.D

B-38

ACCESSION NO.	79P0068520
PATENT NO	US PATENT 4,119,772
TITLE(MONO)	LEAD--ACID CELLS AND BATTERIES
EDITOR OR COMP	PETERS, K.; FEWSTER, S.; WILSON, F.; KEARNEY, K.D.N.
PAT ASSIGNEE	TO CHLORIDE GROUP LTD.
FILED DATE	PRIORITY DATE 31 OCT 1974, UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND (UK)
PAGE NO	20
DATE	10 OCT 1978
CATEGORIES	EDB-250901
PRIMARY CAT	EDB-250901
AUGMENTATION	PATENT
ABSTRACT	A SEALED LEAD--ACID CELL IS DISCLOSED WHICH HAS ELECTRODES COMPRISING METALLIC SUPPORTS WHICH MINIMIZE THE EVOLUTION OF HYDROGEN AND RESIST DEFORMATION UNDER THEIR OWN WEIGHT, AND WHICH ARE SEPARATED BY AT LEAST ONE LAYER OF SEPARATOR MATERIAL. THE CAPACITY OF THE NEGATIVE ELECTRODES IS ARRANGED TO BE AT LEAST AS GREAT AS THE CAPACITY OF THE POSITIVE ELECTRODES. THE THICKNESS OF THE ELECTRODES IS LESS THAN 3MM; THE THICKNESS OF THE SEPARATOR IS IN THE RANGE OF 10% TO 200% OF THE THICKNESS OF THE ELECTRODES; AND THE VOLUME OF ELECTROLYTE IN THE CELL IN RELATION TO THE SUM OF THE PORE VOLUME OF THE SEPARATORS, X, AND THE PORE VOLUME OF THE POSITIVE AND NEGATIVE ACTIVE MATERIALS, Y, IS NOT GREATER THAN 2X + Y. 12 FIGURES, 4 TABLES.
DESCRIPTORS	BATTERY SEPARATORS;DESIGN: Q1;ELECTRODES;ELECTROLYTES;LEAD; LEAD-ACID BATTERIES: M1;THICKNESS

B-39

ACCESSION NO.	79X0068516
TITLE(MONO)	SODIUM--SULFUR BATTERY DEVELOPMENT PROGRAM, PHASE II. FINAL REPORT, JUNE 1976--OCTOBER 31, 1977
EDITOR OR COMP	TOPOUZIAN, A.
CORPORATE AUTH	FORD MOTOR CO., DEARBORN, MI (USA). SCIENTIFIC AND RESEARCH LAB.
PAGE NO	213
AVAILABILITY	DEP. NTIS, PC A10/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2566
DATE	1977
CATEGORIES	EDB-250901;250904;200107;330300
PRIMARY CAT	EDB-250901
REPORT NO	TID--28939
ABSTRACT	THE PHASE II SODIUM--SULFUR BATTERY DEVELOPMENT PROGRAM WAS ORGANIZED ALONG FIVE TASKS: ELECTRIC VEHICLE DEVELOPMENT AND DEMONSTRATION, LOAD LEVELING, CONTAINER AND SEAL DEVELOPMENT, DEVELOPMENT OF CERAMIC ELECTROLYTE AND SEAL TECHNOLOGY, AND FABRICATION AND TESTING. VEHICLE BATTERY STUDIES FOR THE CVS CYCLE ESTABLISHED A 44-KW NA/S BATTERY NEED FOR POWERING A 1134 KG EV EQUIPPED WITH MANUAL TRANSMISSION AND EMPLOYING REGENERATIVE BRAKING. A CONCEPTUAL DESIGN OF A 5-MWH BATTERY WAS DEVELOPED BASED UPON CONSIDERATION OF SYSTEM REQUIREMENTS, FAULT ISOLATION AND MONITORING, THERMAL AND CHARGE CONTROL FACTORS. STATIC CORROSION TESTS WERE USED TO SCREEN POTENTIAL CANDIDATES FOR THE SULFUR CONTAINER MATERIAL SYSTEM. EXTENSIVE EXPLORATORY CELL TESTING ESTABLISHED THE MARK I PROTOTYPE CELL SULFUR CONTAINER MATERIAL SYSTEM: SILICATE-BONDED GRAPHITE COATING (TIODIZE CC-400)ON LOW-CRACK-DENSITY CHROMIUM ELECTROPLATED ON E-BRITE STAINLESS STEEL. A PRE-PILOT CERAMIC PLANT WAS ESTABLISHED TO PRODUCE QUALITY CERAMIC ELECTROLYTE TUBING AT A RATE OF 200 TUBES/MONTH. THE PILOT PLANT FOR PRODUCING CERAMIC ELECTROLYTE HAS BEEN PLANNED, DESIGNED AND CONSTRUCTED. THIS FACILITY WILL HAVE THE CAPACITY ULTIMATELY TO PRODUCE 150 $BETA$''-ALUMINA TUBES PER DAY. OVER 85 CELLS WERE ASSEMBLED AND EVALUATED. THESE CELLS WERE DESIGNED PRIMARILY TO EVALUATE DIFFERENT CANDIDATE MATERIAL SYSTEMS FOR THE SULFUR CONTAINER. THE CELLS ALSO PROVIDE A TEST BED FOR DEVELOPING IMPROVED SEAL AND ASSEMBLY PROCEDURES, FOR EVALUATING INTERMEDIATE SIZE CERAMIC TUBES (1.5 X 20 CM) AND FOR CHARACTERIZING ELECTRICAL PROPERTIES OF SULFUR ELECTRODES IN LARGER CELLS. TWENTY INDIVIDUAL CELL TEST STATIONS WITH AUTOMATIC TEST CONTROLS ARE IN OPERATION AT FORD--DEARBORN. 63

	FIGURES, 25 TABLES.
DESCRIPTORS	CERAMICS;CORROSION;DESIGN;ELECTRIC-POWERED VEHICLES: T2; ELECTROLYTES;FABRICATION;MATERIALS;OFF-PEAK ENERGY STORAGE: T3; PERFORMANCE TESTING;RESEARCH PROGRAMS: Q1;SEALS;SODIUM-SULFUR BATTERIES: T1,Q2,Q3;TUBES

B-40

ACCESSION NO.	79J0062232
TITLE	SELECTION, OPERATION, AND MAINTENANCE OF STANDBY BATTERY SYSTEMS
AUTHORS	BODEN, D.P.
AUTHOR AFF	ELTRA CO, PLYMOUTH MEETING, PA
PUB DESC	PLANT ENG. (BARRINGTON, ILL.), V. 32, NO. 25, PP. 133-136
DATE	7 DEC 1978
CATEGORIES	EDB-250904
PRIMARY CAT	EDB-250904
ABSTRACT	IN ADDITION TO PROVIDING DEPENDABLE CONTROL POWER, STANDBY BATTERIES IN GENERATING PLANTS PROVIDE POWER FOR CRITICAL APPLICATIONS SUCH AS DRIVING MULTIHUNDRED-HORSEPOWER TURBINE EMERGENCY OIL PUMPS. IN RECENT YEARS, THE USE OF STANDBY BATTERY SYSTEMS HAS BEEN GREATLY EXTENDED BECAUSE OF AN INCREASED AWARENESS OF THE NEED TO PROVIDE RELIABLE POWER FOR FIRE-DETECTION AND ALARM SYSTEMS, EMERGENCY LIGHTING, AND SECURITY ALARM AND SURVEILLANCE SYSTEMS, AND AN UPSURGE IN THE USE OF COMPUTERS. STANDBY BATTERY SYSTEMS CAN BE EQUIPPED WITH NICKEL-IRON, NICKEL-CADMIUM, OR LEAD-ACID BATTERIES. EACH TYPE HAS ADVANTAGES OR DISADVANTAGES, BUT THE LEAD-ACID BATTERY IS THE OVERWHELMING FAVORITE FOR GENERAL INDUSTRIAL APPLICATIONS. SELECTING A STANDBY BATTERY SYSTEM REQUIRES CONSIDERATION OF MANY FACTORS OTHER THAN THE TYPE OF BATTERY. WILL THE SYSTEM SERVE ONLY DC LOADS, OR WILL THE BATTERY OPERATE WITH AN INVERTER TO SERVE AC LOADS. WHAT DUTY CYCLE WILL BE IMPOSED ON THE SYSTEM. IS THE SYSTEM INTENDED TO SERVE RELATIVELY LIGHT LOADS FOR A FAIRLY LONG PERIOD, OR IS THE SYSTEM INTENDED TO SUPPLY RELATIVELY HEAVY LOADS FOR ONLY BRIEF PERIODS. HOW MUCH VALUE SHOULD BE PLACED ON FACTORS SUCH AS BATTERY LIFE AND REDUCED BATTERY MAINTENANCE. THE TYPE OF CHARGING EQUIPMENT AND THE BATTERY LOCATION MUST ALSO BE SELECTED. THE ARTICLE DISCUSSES THESE POINTS WITH THE AIM OF PROVIDING GUIDELINES FOR SELECTION AND USE TO FIT PARTICULAR NEEDS.
DESCRIPTORS	ACCIDENTS;ELECTRIC BATTERIES: T1,Q2;ELECTRICAL FAULTS; INDUSTRIAL PLANTS: T2;IRON-NICKEL BATTERIES: T3;LEAD-ACID BATTERIES: T5;MAINTENANCE: Q1;NICKEL-CADMIUM BATTERIES: T4; OPERATION;POWER SUPPLIES: Q2;RECOMMENDATIONS;USES: Q3,Q4,Q5

B-41

ACCESSION NO.	79X0055705
TITLE(MONO)	FORD/D.O.E. SODIUM--SULFUR BATTRY ELECTRIC VEHICLE DEVELOPMENT AND DEMONSTRATION, PHASE I. QUARTERLY PROGRESS REPORT NO. 37, DECEMBER 1, 1977--FEBRUARY 28, 1978
EDITOR OR COMP	TOPOUZIAN, A.
CORPORATE AUTH	FORD MOTOR CO., DEARBORN, MI (USA)
PAGE NO	27
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2566
DATE	1978
CATEGORIES	EDB-330300;250900
PRIMARY CAT	EDB-330300
REPORT NO	COO--2566-37
ABSTRACT	PROGRESS IN DEVELOPING AN ELECTRIC VEHICLE WITH SODIUM--SULFUR BATTERIES IS REPORTED. INFORMATION IS INCLUDED ON NAS CELL AND BATTERY TRADE-OFF STUDIES; PRELIMINARY VEHICLE PACKAGING STUDIES; PROJECTS ON VEHICLE PERFORMANCE AND COST; AND MOTOR/CONTROLLER STUDIES. (LCL)
DESCRIPTORS	CONTROL EQUIPMENT;COST;DESIGN;ELECTRIC MOTORS;ELECTRIC-POWERED VEHICLES: T1;ENERGY CONSERVATION;MECHANICAL TRANSMISSIONS; PERFORMANCE;RESEARCH PROGRAMS: Q1,Q2;SODIUM-SULFUR BATTERIES: T2,Q1

B-42

ACCESSION NO.	79P0065262
PATENT NO	GERMAN(FRG) PATENT 1,771,029/C/
TITLE(MONO)	ACCUMULATOR BATTERY IN WHICH EACH CELL IS SEPARATED BY A DIAPHRAGM PLATE INTO AN ANOLYTE ZONE FILLED WITH ALKALI METAL AND A CATOLYTE ZONE FILLED WITH A SULPHUR-CONTAINING SUBSTANCE

EDITOR OR COMP	KUMMER, J.T.
PAT ASSIGNEE	TO FORD-WERKE A.G., KOELN (GERMANY, F.R.); DEUTSCHES PATENTAMT, MUENCHEN (GERMANY, F.R.)
PAGE NO	7
DATE	24 MAR 1977
LANGUAGE	IN GERMAN
CATEGORIES	EDB-250903;250901
PRIMARY CAT	EDB-250903
AUGMENTATION	GERMAN PATENT
ABSTRACT	THE POWER DENSITY OF ALKALI METAL-SULFUR BATTERIES IS INCREASED ACCORDING TO THE INVENTION BY ARRANGING A POROUS PLATE TOUCHING EACH SIDE OF THE CATION-PERMEABLE SEPARATING WALL TO CONDUCT AND DISTRIBUTE THE IONS, WHICH IN TURN EACH BORDER ANOTHER POROUS, SPRING-LOADED PLATE WHOSE PORE DIAMETER IS CONSIDERABLY LARGER THAN THAT OF THE INNER PLATES. THE PLATES FACING THE POSITIVE ELECTRODES ARE FILLED WITH SULFUR-CONTAINING, ELECTROCHEMICALLY REVERSIBLE CATHODE SUBSTANCE AND THE PLATES FACING THE NEGATIVE ELECTRODE, WITH THE ANODIC ALKALI METAL MELT.
DESCRIPTORS	ALKALI METALS;BATTERY SEPARATORS: Q1;DESIGN;PLATES;POROSITY; POROUS MATERIALS;SODIUM-SULFUR BATTERIES: T1

B-43

ACCESSION NO.	79J0055243
TITLE	ADVANCES IN THE FIELD OF LEAD-ACID BATTERIES
AUTHORS	BERNDT, D.
AUTHOR AFF	VARTA BATTERIE A.G., KELKHEIM (GERMANY, F.R.). BEREICH NEUE PRODUKTION
PUB DESC	ELEKTROTECH. Z., A. V. 99, NO. 9, PP. 540-543
DATE	SEP 1978
LANGUAGE	IN GERMAN
CATEGORIES	EDB-250902
PRIMARY CAT	EDB-250902
ABSTRACT	DUE TO FUNDAMENTAL LIMITATIONS A SUBSTANTIAL INCREASE CANNOT BE EXPECTED CONCERNING THE SPECIFIC ENERGY OF THE LEAD-ACID BATTERY. NEVERTHELESS, THE FURTHER DEVELOPMENT OF THIS MOST IMPORTANT STORAGE BATTERY SYSTEM IS PUSHED FORWARD WITH GREAT EMPHASIS. LOW-ANTIMONY OR ANTIMONY-FREE GRID ALLOYS AS WELL AS HYDROGEN/OXYGEN RECOMBINATION DEVICES ARE EXTENDING THE TOPPING-UP INTERVALS. AUTOMATIC REFILLING DEVICES MAKE TOPPING-UP VERY SIMPLE. ALTOGETHER MAINTENANCE EFFORTS ARE REDUCED TO A GREAT DEGREE. LEAD-ACID BATTERIES ADAPTED TO SPECIAL APPLICATIONS (CONTINUOUS CHARGE-DISCHARGE OPERATION IN BATTERY PROPELLED BUSSES) ARE TO HAVE COOLING DEVICES TO CARRY OFF THE HEAT, ORIGINATED MAINLY IN THE CHARGING PERIOD.
DESCRIPTORS	BATTERY CHARGING;CAPACITY;LEAD-ACID BATTERIES: T1;MAINTENANCE; PERFORMANCE: Q1;TECHNOLOGY ASSESSMENT

B-44

ACCESSION NO.	79R0054503
TITLE(MONO)	ENERGY STORAGE FOR PHOTOVOLTAIC CONVERSION. VOLUME II. UTILITY SYSTEMS. FINAL REPORT
EDITOR OR COMP	FEDUSKA, W.; KIRSCHBAUM, H.S.; CHLJANIEC, C.R.; MASKALICK, N.J.; MAITLEN, J.L.; PITTMAN, R.F.; WOLFE, M.; WOOD, P.; WORRELL, W.L.
CORPORATE AUTH	WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA (USA). RESEARCH AND DEVELOPMENT CENTER
PAGE NO	192
AVAILABILITY	DEP. NTIS, PC A09/MF A01.
CONTRACT NO	CONTRACT EY-76-C-04-2744
DATE	30 SEP 1977
CATEGORIES	EDB-140600;250901;250902;140501
PRIMARY CAT	EDB-140600
REPORT NO	TID--28761
ABSTRACT	WESTINGHOUSE ELECTRIC CORPORATION HAS UNDERTAKEN, FOR THE NATIONAL SCIENCE FOUNDATION, A TWELVE-MONTH STUDY PROGRAM BOTH TO EVALUATE THE NATURE, MODE OF OPERATION, AND USEFULNESS AND TO DEFINE ACTIONS, REGARDING TECHNICAL AND/OR IMPLEMENTATION PROBLEMS, REGARDING BATTERY STORED ENERGY, WHEN APPLIED TO BOTH SINGLE-FAMILY RESIDENCES AND UTILITY CENTRAL STATION SYSTEMS THAT WOULD USE PHOTOVOLTAIC-DERIVED ELECTRICITY IN THE TIME FRAME 1986 TO 1995. THE PROGRAM ENTAILED SIX TASKS: SYSTEMS ANALYSIS; COMPONENT REQUIREMENTS; CONCEPTUAL DESIGN; STORAGE SYSTEM EVALUATION AND SCREENING; PRELIMINARY DESIGN; AND R AND

	D REQUIREMENTS AND UTILIZATION PLAN. THIS REPORT COMPILES THE RESULTS OF THE FINDINGS OF ALL OF THESE TASKS, RELATED SOLELY TO THE UTILITY SYSTEMS PORTIONS OF THE PROGRAM, EACH OF WHICH HAD PREVIOUSLY BEEN SEPARATELY REPORTED, AS WELL AS THE OVERALL CONCLUSIONS OF THE TOTAL STUDY. IT DEFINES TWO PREFERRED BATTERY SYSTEMS--ADVANCED TECHNOLOGY LEAD--ACID AND ZINC--CHLORINE--DERIVED FROM A RANKING AND WEIGHTING TECHNIQUE EVOLVED IN SCREENING 9 BATTERY SYSTEM CANDIDATES. IT DESCRIBES HOW THE BATTERY SYSTEMS ARE USED IN THE UTILITY AND DEFINES THE NATURE OF THESE SYSTEMS (COMPLETE WITH ALL AUXILIARIES, MAINTENANCE, AND SAFETY SYSTEMS) IN THE CONTEXT OF A 500 MWH PLANT SIZE (125 MW FOR 4 HOURS). IT DESCRIBES THE TECHNICAL AND ECONOMIC ASPECTS OF USING THOSE SYSTEMS AND THE NATURE, TECHNICAL STATUS, MANNER OF USAGE, AND ECONOMICS OF THE INTERFACING POWER CONDITIONING EQUIPMENT. ALSO IT RELATES THE TECHNICAL AND INSTITUTIONAL OBSTACLES TO BE OVERCOME TO ENSURE THIS USAGE. FINALLY THIS REPORT DESCRIBES COURSES OF ACTIONS FOR USEFUL DISSEMINATION OF THE INFORMATION COMPILED.
DESCRIPTORS	AUXILIARY SYSTEMS;COST;DESIGN: U1,U2,U4,U5;ELECTRIC BATTERIES; ELECTRIC UTILITIES;ENERGY STORAGE SYSTEMS: Q1,Q2;EQUIPMENT INTERFACES;EVALUATION: U4,U5;LEAD-ACID BATTERIES: T4;LIFE-CYCLE COST;MAINTENANCE;PHOTOVOLTAIC POWER PLANTS: T2;PHOTOVOLTAIC POWER SUPPLIES: T1,U3;POWER CONDITIONING CIRCUITS;RELIABILITY; RESIDENTIAL BUILDINGS: T3;SAFETY;SERVICE LIFE;SIZE;SYSTEMS ANALYSIS;ZINC-CHLORINE BATTERIES: T5

B-45

ACCESSION NO.	79J0049431
TITLE	REVIEW OF THE CURRENT STATUS AND FUTURE PROSPECTS OF BATTERY-POWERED ELECTRIC ROAD VEHICLES
AUTHORS	VAN WYK, J.D.N.
AUTHOR AFF	CSIR, NATL ELECTR ENG RES INST, PRETORIA, S AFR
PUB DESC	TRANS. S. AFR. INST. ELECTR. ENG., V. 69, PP. 26-43
DATE	FEB 1978
CATEGORIES	EDB-330300;250904
PRIMARY CAT	EDB-330300
ABSTRACT	THE HISTORY OF ELECTRIC VEHICLES AND THE PRESENT SITUATION REGARDING THESE VEHICLES ARE DISCUSSED, AND DESIGN PARAMETERS SUCH AS THE FIELD OF APPLICATION, TRIP STATISTICS, POWER REQUIREMENTS, POWER SOURCE AND RANGE ARE MENTIONED. POSSIBLE FUTURE BATTERY SYSTEMS ARE ALSO DISCUSSED, WITH REFERENCE TO A NUMBER OF AQUEOUS, METAL-AIR AND HIGH TEMPERATURE BATTERIES. TRACTION SYSTEMS ARE DEALT WITH, AND REFERENCE IS MADE TO THE GENERAL CONSIDERATIONS OF A TYPICAL CONTROLLER FOR A MOTOR WITH SEPARATE FIELD EXCITATION, AS USED IN BATTERY-DRIVEN VEHICLES. ECONOMIC CONSIDERATIONS ARE MENTIONED AND THE PURCHASE COSTS, OPERATING COSTS AND TOTAL COSTS OF THE ELECTRIC VEHICLE ARE COMPARED WITH THAT OF THE PETROL-DRIVEN VEHICLE. THE POSSIBLE APPLICATIONS AND FUTURE ROLE OF THESE VEHICLES IN SOUTH AFRICA ARE CONSIDERED. THE ADVANTAGES OF BATTERY-DRIVEN VEHICLES FOR COUNTRIES DEPENDENT ON OVERSEAS ENERGY RESOURCES AND THE EXPECTED EXTRA LOAD ON THE SUPPLY NETWORK ARE BRIEFLY MENTIONED. 22 REFS.
DESCRIPTORS	CAPITAL;DESIGN: U1;ECONOMICS;ELECTRIC BATTERIES: T; ELECTRIC-POWERED VEHICLES: T1;ELECTRICAL EQUIPMENT;IRON-AIR BATTERIES;IRON-NICKEL BATTERIES;LEAD-ACID BATTERIES; LITHIUM-SULFUR BATTERIES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;PERFORMANCE;REVIEWS;SODIUM-SULFUR BATTERIES;SOUTH AFRICA;ZINC-AIR BATTERIES

TITLE	ENGINES AND ENERGY: FUTURE TRENDS
AUTHORS	AGNEW, W.G.
AUTHOR AFF	GENERAL MOTORS RESEARCH LAB., WARREN, MI
TITLE(MONO)	PROCEEDINGS OF A SYMPOSIUM ON IMPLICATIONS OF ENERGY CONSERVATION AND SUPPLY ALTERNATIVES
SEC REPT NO	CONF-780150--
PAGE NO	171-216
CONF TITLE	SYMPOSIUM ON IMPLICATIONS OF ENERGY CONSERVATION AND SUPPLY ALTERNATIVES
CONF PLACE	COLORADO SPRING, CO, USA
CONF DATE	30 JAN 1978
PUBL LOC	SCIENCE APPLICATIONS, INC., EAST BRUNSWICK, NJ

DATE	1976
CATEGORIES	EDB-296000;330100
PRIMARY CAT	EDB-296000
ABSTRACT	DR. AGNEW POINTS OUT THAT IN THE NEAR-TERM (TO ABOUT 1990), NEW ENERGY SOURCES SUCH AS SYNTHETIC FUELS CANNOT MAKE SUBSTANTIAL CONTRIBUTIONS. IN THE LONG TERM (2000 AND BEYOND), WHEN PETROLEUM RESOURCES WILL BE SHORT, WE WILL HAVE TO CONVERT TO SYNTHETIC FUELS DERIVED FROM TAR SANDS, SHALES, OR COAL. THE TRANSPORTATION SECTOR CONSUMES 26% OF ALL U.S. ENERGY AND 55% OF THE PETROLEUM SUPPLY. THE AUTOMOTIVE INDUSTRY IS CONDUCTING POWER-PLANT R AND D PROGRAMS INVOLVING NEAR-TERM MODIFICATIONS TO THE CONVENTIONAL SPARK-IGNITION GASOLINE ENGINE, AS WELL AS RESEARCH ON ALTERNATES TO THE CONVENTIONAL SPARK-IGNITION ENGINE FOR THE LONG-TERM SITUATION. DR. AGNEW SEES IMPROVED CONVENTIONAL ENGINES, LIGHT-DUTY DIESEL ENGINES, AND STRATIFIED-CHARGE ENGINES AS FEASIBLE IN 1976 TO 1985; GAS-TURBINE ENGINES, ELECTRIC BATTERY-POWERED VEHICLES, AND METHANOL-FUELED ENGINES FOR 1985 TO 2000; AND HYDROGEN-FUELED ENGINES AND FUEL CELLS FOR 2000 AND BEYOND. EACH SYSTEM IS BRIEFLY DISCUSSED. A LENGTHY ROUNDTABLE DISCUSSION FOLLOWED. (MCW)
DESCRIPTORS	AUTOMOTIVE FUELS;COMPARATIVE EVALUATIONS;DIESEL ENGINES; ECONOMICS;ELECTRIC-POWERED VEHICLES;ENERGY;ENGINES: T4,05; FEASIBILITY STUDIES;FORECASTING: 04;FUEL CELLS;GAS TURBINES: T2; HYDROGEN;INTERNAL COMBUSTION ENGINES: T1;METHANOL;REVIEWS; STRATIFIED CHARGE ENGINES: T3;SYNTHETIC FUELS;TECHNOLOGY ASSESSMENT: 01,02,03;TECHNOLOGY UTILIZATION;VEHICLES: T5

B-46

ACCESSION NO.	79C0048792
TITLE	STRENGTHENING OF BETA-ALUMINA
AUTHORS	MAY, G.J.
AUTHOR AFF	CHLORIDE SILENT POWER LTD., CHESHIRE, ENGLAND
TITLE(MONO)	GRAIN BOUNDARIES
SEC REPT NO	CONF-7604159--
PAGE NO	F.1-F.7
CONF TITLE	GRAIN BOUNDARIES, SPRING RESIDUAL CONFERENCE
CONF PLACE	JERSEY, UK
CONF DATE	9 APR 1976
PUBL LOC	INSTITUTION OF METALLURGISTS, LONDON, ENGLAND
DATE	1976
CATEGORIES	EDB-250903;360203;360202
PRIMARY CAT	EDB-250903
ABSTRACT	BETA-ALUMINA IS A COMPLEX SODIUM ALUMINATE THAT HAS A RELATIVELY HIGH CONDUCTIVITY FOR SODIUM IONS IN THE SOLID STATE AND A LOW ELECTRONIC CONDUCTIVITY. IT IS USED IN THE SODIUM/SULFUR BATTERY, WHERE IT FUNCTIONS BOTH AS AN ELECTROLYTE FOR SODIUM IONS AND AS A SEPARATOR FOR THE TWO MOLTEN ELECTRODES. THE HIGH IONIC CONDUCTIVITY RESULTS FROM THE PRESENCE OF WIDELY SPACED PLANES IN THE BETA-ALUMINA LATICE, BONDED BY OXYGEN BRIDGES, IN WHICH SODIUM IONS ARE MOBILE; BUT THESE PLANES FORM EASY CLEAVAGE PATHS, RESULTING IN AN INTRINSICALLY WEAK MATERIAL. SATISFACTORY STRENGTH CAN, HOWEVER, BE ACHIEVED WITH A SUFFICIENTLY FINE-GRAIN-SIZED MATERIAL, PROVIDED THAT THERE ARE NO DEFECTS ABOVE A CRITICAL SIZE. A FRACTOGRAPHIC STUDY WAS CARRIED OUT TO CHARACTERIZE THE GENERAL FEATURES OF THE FRACTURE BEHAVIOR AND THE INFLUENCE OF GRAIN SIZE AND DEFECT SIZE ON THE FRACTURE STRENGTH. THE EFFECT OF SODIUM ION TRANSPORT ON THE MECHANICAL PROPERTIES OF BETA-ALUMINA ARE ALSO DISCUSSED. 8 FIGURES.
DESCRIPTORS	ALUMINIUM OXIDES: T1;BATTERY SEPARATORS: 03;CRACKS;CRYSTAL DEFECTS;ELECTROLYTES: 03;FRACTURE PROPERTIES: 01,02;GRAIN SIZE; ION MOBILITY;MECHANICAL PROPERTIES;MICROSTRUCTURE: 01,02;SODIUM IONS;SODIUM OXIDES: T2;SODIUM-SULFUR BATTERIES: T3

B-47

ACCESSION NO.	79J0048748
TITLE	RECENT ADVANCES IN THE DEVELOPMENT OF SODIUM--SULFUR BATTERIES FOR LOAD LEVELLING AND MOTIVE POWER APPLICATIONS
AUTHORS	JONES, I.W.
AUTHOR AFF	CHLORIDE SILENT POWER LTD., RUNCORN, ENGLAND
PUB DESC	ELECTROCHIM. ACTA, V. 22, NO. 7, PP. 681-688
DATE	JUL 1977
CATEGORIES	EDB-250901;250903

PRIMARY CAT	EDB-250901
AUGMENTATION	150 WH/KG; NA FED BY WICK
ABSTRACT	SOME RECENT PROGRESS IN THE DESIGN AND DEVELOPMENT OF SODIUM/SULFUR BATTERIES FOR MOTIVE POWER APPLICATIONS ARE DESCRIBED. THE HISTORICAL DEVELOPMENT OF CELL DESIGNS OVER THE LAST 10 Y IS REVIEWED, AND INCLUDES A DISCUSSION OF DEVELOPMENT PROBLEMS SUCH AS THE DURABILITY OF BETA-ALUMINA AND CORROSION OF THE SULFUR ELECTRODE COLLECTOR. THE TUBULAR ELECTROLYTE IS NOW WIDELY ADOPTED AS THE PREFERRED DEVELOPMENT OPTION, AND A COMPUTER ANALYSIS SHOWS THAT A VOLUMETRIC ENERGY DENSITY OF ABOUT 200 WH/LITRE CAN BE OBTAINED IN AN OPTIMUM DESIGN OF A BATTERY INCLUDING THERMAL INSULATION. AN ADVANCED CELL DESIGN WAS ADOPTED IN WHICH SODIUM IS FED INTO THE ANODIC REACTION ZONE BY A CAPILLARY WICK. THIS DESIGN IS WELL SUITED TO THE DEMANDS OF MOTIVE POWER APPLICATIONS IN WHICH THE STORED ENERGY HAS TO BE SUPPLIED AT ABOUT THE 2H RATE. THE DESIGN ALSO PERMITS THE USE OF LARGE ELECTROLYTE TUBES, AT LEAST 30 MM DIA X 500 MM IN LENGTH, AND THIS REDUCES THE BATTERY MANUFACTURING COSTS. A LARGE NUMBER OF EXPERIMENTAL CELLS WERE TESTED, AND OVER 85% UTILIZATION OF THE SODIUM AND SULFUR ACTIVE MATERIALS WAS ACHIEVED FOR REPEATED CYCLING OF DEVELOPED ELECTRODE CONSTRUCTIONS. 9 FIGURES.
DESCRIPTORS	ALUMINIUM OXIDES;ANODES: U1;AUTOMOBILES;CATHODES;CONNECTORS; COST;DESIGN: U1;EFFICIENCY;ELECTRIC-POWERED VEHICLES: T2; ELECTROLYTES;HIGH TEMPERATURE;MANUFACTURING;OFF-PEAK ENERGY STORAGE;PERFORMANCE;RAILWAYS;SODIUM OXIDES;SODIUM-SULFUR BATTERIES: M1,U2;THERMAL INSULATION;TRUCKS;TUBES

B-48

ACCESSION NO.	79X0046743
TITLE(MONO)	FORD/ERDA SODIUM—SULFUR BATTERY DEVELOPMENT: PHASE I. FINAL REPORT, JUNE 15, 1975--MARCH 31, 1976
EDITOR OR COMP	WEINER, S.A.
CORPORATE AUTH	FORD MOTOR CO., DEARBORN, MI (USA). SCIENTIFIC AND RESEARCH LAB.
PAGE NO	36
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2566
DATE	JUL 1976
CATEGORIES	EDB-250901
PRIMARY CAT	EDB-250901
AUGMENTATION	$SUP 286$ W/KG, 44 WH/KG
REPORT NO	TID--28969
ABSTRACT	THE PRE-PILOT FACILITY FOR THE BATCH PRODUCTION OF $BETA$''ALUMINA TUBING WAS DESIGNED AND REMODELED. CRITICAL ITEMS OF CAPITAL EQUIPMENT WERE SPECIFIED AND PLACED ON ORDER. WORK BEGAN ON THE CONSTRUCTION OF THE PRE-PILOT SPRAY DRYER AND THE BATCH AND CONTINUOUS SINTERING FURNACES. PRELIMINARY CONTACTS WERE MADE WITH A COMMERCIAL VENDOR OF ISOSTATIC PRESSES CONCERNING THE SPRAY DRYING OF MATERIALS SUITABLE FOR AUTOMATIC ISOSTATIC PRESSING. A TENTATIVE TESTING PROGRAM WAS ARRANGED TO PERMIT EVALUATION OF AUTOMATIC ISOSTATIC PRESSING EQUIPMENT FOR EVENTUAL PURCHASE AND INSTALLATION IN THE PILOT PLANT. CELLS INCORPORATING HIGH-POWER-DENSITY ELECTRODE DESIGN AND STAINLESS STEEL CONTAINERS FOR SODIUM AND SULFUR WERE DESIGNED, CONSTRUCTED, AND TESTED. THE FIRST CELL DELIVERED AN AVERAGE OF 286 W/KG DURING ONE DISCHARGE CYCLE AT 750 MA/CM$SUP 2$. THE ENERGY DENSITY WAS 44 WH/KG AT THIS HIGH CURRENT DENSITY, WHEREAS AT 50 MA/CM$SUP 2$ OVER 80 WH/KG COULD BE REACHED. THE CELL BECAME NON-FARADAIC AFTER 45 DAYS BECAUSE OF CERAMIC FAILURE. A CELL WITH SEPARATE COMPARTMENTS FOR CHARGING AND DISCHARGING AND WITH ELECTRODES OPTIMIZED FOR EITHER TASK WAS TESTED SUCCESSFULLY. EFFORTS TO DEVELOP CORROSION RESISTANT SULFUR CONTAINER MATERIALS WERE INITITATED. STATIC SODIUM TETRASULFIDE CORROSION TESTS WERE CONDUCTED AT 400$SUP 0$C ON SUBSTRATES WITH AND WITHOUT VARIOUS SURFACE TREATMENTS AND PROTECTIVE COATINGS. THE RESULTS SHOWED THAT ALUMINUM, MOLYBDENUM, FERRITIC STAINLESS STEELS, AND INCONELS SHOW VARYING DEGREES OF PROMISE. THE FIRST CELL TESTED UNDER THIS PROGRAM WAS THOROUGHLY EXAMINED AFTER FAILURE. THE COATING OF GRAPHITE FILLED POLYPHENYLENE RESIN APPLIED TO THE AISI 446 STAINLESS STEEL CONTAINER HAD NOT STOOD UP SATISFACTORILY PERHAPS OWING TO OVERHEATING. THERE WERE NO SIGNS OF DEGRADATION OF ANY OF THE SEALS. 21 FIGURES.
DESCRIPTORS	ALUMINIUM OXIDES;CONTAINERS;CORROSION;ELECTRODES;ELECTROLYTES;

FABRICATION;MATERIALS;PERFORMANCE;RESEARCH PROGRAMS: Q1;SODIUM OXIDES;SODIUM-SULFUR BATTERIES: M1;TUBES

B-49

ACCESSION NO.	79C0042323
TITLE(MONO)	MATERIALS FOR HIGH-PERFORMANCE LITHIUM ALUMINUM/IRON SULFIDE SECONDARY BATTERIES
EDITOR OR COMP	SWAROOP, R.B.; SMAGA, J.A.; BATTLES, J.E.
CORPORATE AUTH	ARGONNE NATIONAL LAB., IL (USA)
PAGE NO	22
AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
CONF TITLE	5. INTER-AMERICAN CONFERENCE ON MATERIALS TECHNOLOGY
CONF PLACE	SAO PAULO, BRAZIL
CONF DATE	5 NOV 1976
DATE	1976
DROP NOTE	PORTIONS OF DOCUMENT ARE ILLEGIBLE
CATEGORIES	EDB-250903
PRIMARY CAT	EDB-250903
REPORT NO	CONF-761113--1
ABSTRACT	LITHIUM--ALUMINUM/IRON SULFIDE SECONDARY BATTERIES ARE BEING DEVELOPED FOR USE AS POWER SOURCES FOR ELECTRIC VEHICLES AND AS STATIONARY ENERGY STORAGE DEVICES FOR LOAD-LEVELING ON ELECTRIC UTILITIES. THE CORROSIVENESS OF THE ACTIVE MATERIALS AND MOLTEN ELECTROLYTE PLACES SEVERE RESTRICTIONS ON THE TYPE OF MATERIALS THAT CAN BE USED FOR CURRENT COLLECTORS, SEPARATORS, AND FEEDTHROUGH INSULATORS. OUT-OF-CELL AND IN-CELL TESTS ARE BEING CONDUCTED TO IDENTIFY THE MATERIALS THAT ARE COMPATIBLE WITH THIS CELL ENVIRONMENT. THE CORROSION TEST PROCEDURES, THE NATURE AND KINETICS OF THE CORROSION REACTIONS, AND THE DEVELOPMENT AND TESTING OF ELECTRODE SEPARATORS ARE DISCUSSED. 5 FIGURES, 5 TABLES.
DESCRIPTORS	ALUMINIUM ALLOYS;BATTERY SEPARATORS: Q3;BORON NITRIDES; CONNECTORS: Q3;CORROSION;ELECTRIC-POWERED VEHICLES: T1; ELECTRICAL INSULATORS;HIGH TEMPERATURE;IRON SULFIDES;LITHIUM ALLOYS;LITHIUM CHLORIDES;LITHIUM-SULFUR BATTERIES: Q1,Q2,T3; MAGNESIUM OXIDES;MATERIALS: Q3;OFF-PEAK ENERGY STORAGE: T2; POTASSIUM CHLORIDES;PYRITE

B-50

ACCESSION NO.	79J0042312
TITLE	SODIUM-SULPHUR BATTERY
AUTHORS	FISCHER, W.; HAAR, W.; HARTMANN, B.; MEINHOLD, H.; WEDDIGEN, G.
PUB DESC	BBC-NACHR., V. 60, NO. 5, PP. 193-199
DATE	1976
LANGUAGE	IN GERMAN
CATEGORIES	EDB-250901
PRIMARY CAT	EDB-250901
ABSTRACT	UNCONVENTIONAL, RECHARGABLE BATTERIES HAVE, IN COMPARISON WITH CONVENTIONAL BATTERIES, A HIGHER ENERGY AND POWER DENSITY AND LONGER LIFE WHILE BEING LOWER IN PRICE. ONE OF THE MOST PROMISING NEW TYPES IS THE SODIUM-SULPHUR BATTERY. THE AUTHORS DESCRIBE THE PRINCIPLE OF OPERATION, THE STATE OF DEVELOPMENT AND THE APPLICATIONS OF THE SODIUM-SULPHUR BATTERY.
DESCRIPTORS	CAPACITY;CHEMICAL REACTIONS: Q1;COMPARATIVE EVALUATIONS; CORROSION;DESIGN: Q1;ELECTROCHEMISTRY;FABRICATION;LEAD-ACID BATTERIES;SERVICE LIFE;SODIUM-SULFUR BATTERIES: T1;USES

B-51

ACCESSION NO.	79R0036524
TITLE(MONO)	SAFETY AND ENVIRONMENTAL ASPECTS OF ZINC--CHLORINE HYDRATE BATTERIES FOR ELECTRIC-VEHICLE APPLICATIONS
EDITOR OR COMP	KODALI, S.; HENRIKSEN, G.L.; WHITTLESEY, C.C.; WARDE, C.J.; CARR, P.; SYMONS, P.C.
CORPORATE AUTH	ENERGY DEVELOPMENT ASSOCIATES, MADISON HEIGHTS, MI (USA)
PAGE NO	60
AVAILABILITY	DEP. NTIS, PC A04/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2966
DATE	MAR 1976
CATEGORIES	EDB-250902;530200
PRIMARY CAT	EDB-250902
REPORT NO	COO--2966-2
ABSTRACT	PUBLIC ACCEPTANCE OF HIGH-PERFORMANCE COST-EFFECTIVE ZINC--CHLORINE HYDRATE BATTERIES FOR THE RANDOM-USE

ELECTRIC-VEHICLE APPLICATION WILL REQUIRE MEETING STRINGENT SAFETY AND ENVIRONMENTAL REQUIREMENTS. THESE REQUIREMENTS REVOLVE MAINLY AROUND THE QUESTION OF ACCIDENTAL RELEASE AND SPREAD OF TOXIC AMOUNTS OF CHLORINE GAS, THE ONLY POTENTIAL HAZARD IN THIS BATTERY SYSTEM. AVAILABLE INFORMATION IN THE AREAS OF PHYSIOLOGICAL EFFECTS, ENVIRONMENTAL IMPACT, AND GOVERNMENTAL REGULATION OF CHLORINE WERE REVIEWED. THE DESIGN, OPERATION, AND SAFETY FEATURES OF A FIRST COMMERCIAL ELECTRIC-VEHICLE BATTERY WERE CONCEIVED AND ANALYZED FROM THE CHLORINE RELEASE ASPECT. TWO TYPES OF ACCIDENT SCENARIOS WERE ANALYZED IN TERMS OF CHLORINE RELEASE RATES, ATMOSPHERIC DISPERSION, HEALTH HAZARD, AND POSSIBLE CLEAN-UP OPERATIONS. THE WORST-CASE SCENARIO, A QUITE IMPROBABLE ACCIDENT, INVOLVES THE SPILLAGE OF CHLORINE HYDRATE ONTO THE GROUND, WHILE THE OTHER SCENARIO, A MORE PROBABLE ACCIDENT, INVOLVES THE RELEASE OF CHLORINE GAS FROM A RUPTURED BATTERY CASE. HEAT-TRANSFER AND CHLORINE-DISPERSION MODELS, DEVELOPED TO ANALYZE THESE SCENARIOS, ESTABLISH A FIRM BASIS FOR A COMPREHENIVE AND FACTUAL POSITION STATEMENT ON THIS TOPIC. THE RESULTS OF THIS PRELIMINARY STUDY SUGGEST THAT ELECTRIC VEHICLES POWERED BY APPROPRIATELY DESIGNED ZINC--CHLORINE HYDRATE BATTERIES WILL POSE NEGLIGIBLE HEALTH OR ENVIRONMENTAL HAZARDS ON THE NATION'S STREETS AND HIGHWAYS. 8 FIGURES, 14 TABLES.

DESCRIPTORS — CHLORINE COMPOUNDS;DESIGN;ELECTRIC-POWERED VEHICLES: T1; ENVIRONMENTAL IMPACTS: 02;HEALTH HAZARDS;HYDRATES;OPERATION; REGULATIONS;SAFETY: 02;ZINC-CHLORINE BATTERIES: 01,T2

B-52

ACCESSION NO. — 79R0036515
TITLE(MONO) — COST ANALYSIS OF 50 KWH ZINC--CHLORINE BATTERIES FOR MOBILE APPLICATIONS
EDITOR OR COMP — CATHERINO, H.; HENRIKSEN, G.L.; WHITTLESEY, C.C.; WARDE, C.J.; CARR, P.; SYMONS, P.C.
CORPORATE AUTH — ENERGY DEVELOPMENT ASSOCIATES, MADISON HEIGHTS, MI (USA)
PAGE NO — 60
AVAILABILITY — DEP. NTIS, PC A04/MF A01.
CONTRACT NO — CONTRACT EY-76-C-02-2966
DATE — JAN 1978
CATEGORIES — EDB-250901
PRIMARY CAT — EDB-250901
REPORT NO — COO--2966-1
ABSTRACT — THE COSTS COMPRISING THE PROJECTED SELLING PRICE OF A 50-KWH ZINC--CHLORINE BATTERY FOR MOBILE APPLICATIONS WERE ANALYZED. THIS ANALYSIS IS PREDICATED ON A BATTERY WHOSE ENGINEERING AND DESIGN SPECIFICATIONS ARE WELL CRYSTALLIZED. SUCH A DESIGN HAS BEEN PROPOSED AND A PROCESS PLAN CONCEIVED. THIS, IN TURN, LED TO A SIMULATED MANUFACTURING PLAN. THIS ANALYSIS SHOWED THAT NO CRITICAL RESOURCES OR COMPLEX MANUFACTURING OPERATIONS ARE REQUIRED. THE PROJECTED COST PRESUMES A PRODUCTION LEVEL OF 25,000 BATTERIES PER YEAR. IN THAT CONTEXT, A SELLING PRICE WAS ESTIMATED, IN MID-1977 DOLLARS, TO BE $1645 PER BATTERY OR $33/KWH. THIS PRICE EXCLUDES THE BATTERY CHARGER, FOR WHICH AN ADDED $400 ($8/KWH) IS CONSIDERED REASONABLE. 8 FIGURES, 19 TABLES.
DESCRIPTORS — AUTOMOBILES;COST: 02;ELECTRIC-POWERED VEHICLES: T1;PRODUCTION; SPECIFICATIONS;ZINC-CHLORINE BATTERIES: T2,01

B-53

ACCESSION NO. — 79R0034997
TITLE(MONO) — ENERGY STORAGE FOR PHOTOVOLTAIC CONVERSION. VOLUME III. RESIDENTIAL SYSTEMS. FINAL REPORT
EDITOR OR COMP — FEDUSKA, W.; FEDERMANN, E.F.; MASKALICK, N.J.; MCALLISTER, W.J.; PITTMAN, P.F.; STOELTZING, R.W.; WOOD, P.; NEARHOOF, S.L.; RITTLEMAN, P.R.; WORNELL, W.
CORPORATE AUTH — WESTINGHOUSE RESEARCH AND DEVELOPMENT CENTER, PITTSBURGH, PA (USA)
PAGE NO — 167
AVAILABILITY — DEP. NTIS, PC A08/MF A01.
CONTRACT NO — CONTRACT EY-76-C-04-2744
DATE — 30 SEP 1977
CATEGORIES — EDB-140501;140704;250901;250902
PRIMARY CAT — EDB-140501
REPORT NO — TID--28779
ABSTRACT — THIS REPORT CONSIDERS ELECTRIC BATTERY STORAGE FOR ON-SITE PHOTOVOLTAIC TOTAL ENERGY SYSTEMS FOR RESIDENCES. IN A SERIES OF SEQUENTIAL TASKS, THE FOLLOWING TOPICS WERE ADDRESSED: (1) OVERALL SYSTEM ANALYSIS (FOR SEVEN U.S. REGIONS); (2) FORMULATION OF BATTERY COMPONENT REQUIREMENTS; (3) CONCEPTUAL DESIGN; (4) BATTERY SYSTEM EVALUATION AND SCREENING; (5) PRELIMINARY DESIGN; AND (6) RESEARCH, DEVELOPMENT, AND UTILIZATION REQUIREMENTS. THE RESULTS OF THIS AND OTHER STUDIES INDICATED THAT: (1) THE OVERALL PHOTOVOLTAIC ON-SITE RESIDENTIAL TOTAL ENERGY SYSTEM WILL EVENTUALLY BE VIABLE IN ALL REGIONS OF THE COUNTRY IF THE 1965 NATIONAL PHOTOVOLTAIC PROGRAM GOALS ARE ACHIEVED AND THERE IS A MODEST GOVERNMENT PRE-COMMERCIALIZATION PROGRAM. (2) THE OPTIMIZED BATTERY ELECTRICAL STORAGE SYSTEM CAPACITY WILL BE ABOUT 20 KILOWATT-HOURS. (3) THE BATTERY WILL ENHANCE THE SYSTEM'S PERFORMANCE BY BOTH INCREASING THE ENERGY DISPLACEMENT BY SOLAR AND REDUCING THE OVERALL SYSTEM COST AS RELATED TO ENERGY DISPLACEMENT. (4) THE BATTERY SYSTEM MOST SUITED AND MOST ECONOMICAL TO RESIDENTIAL USAGE IS THE ADVANCED TECHNOLOGY LEAD-ACID BATTERY. INSTITUTIONAL FACTORS WERE CONSIDERED; THERE APPEARS TO BE NO SEVERE PROBLEM, ESPECIALLY IF ANTICIPATED PROBLEMS ARE ADDRESSED EARLY. A LONG-RANGE PROGRAM IS SUGGESTED TO DEVELOP THE BATTERY SUBSYSTEM AND TO COMBINE IT WITH THE ASSOCIATED POWER CONDITIONING AND OTHER RELATED EQUIPMENT, SO THAT THE ENTIRE ELECTRICAL SYSTEM REQUIRED FOR OPERATION OF THE PHOTOVOLTAIC ARRAY CAN BE DELIVERED AS A SINGLE PACKAGE.
DESCRIPTORS — BATTERY CHARGING;COST;DESIGN: 01,03;ELECTRIC BATTERIES;ENERGY STORAGE SYSTEMS: 01;EVALUATION: 03;INSOLATION;LEAD-ACID BATTERIES: T3;MAINTENANCE;MATHEMATICAL MODELS;PHOTOVOLTAIC POWER PLANTS: T1,02;REGIONAL ANALYSIS;RESIDENTIAL BUILDINGS: T2; SAFETY;SIMULATION;SYSTEMS ANALYSIS;TOTAL ENERGY SYSTEMS: T,01

B-54

ACCESSION NO.	79J0025373
TITLE	PRESENT TECHNICAL SITUATION CONCERNING LEAD TRACTION BATTERIES FOR INDUSTRIAL TRUCKS
AUTHORS	KIEHNE, H.A.
AUTHOR AFF	VARTA BATTERIE A.G., KELKHEIM (GERMANY, F.R.). FORSCHUNGS- UND ENTWICKLUNGSZENTRUM
PUB DESC	VARTA SPEZ. REP., NO. 2, PP. 517-533
DATE	1977
LANGUAGE	IN GERMAN
CATEGORIES	EDB-250902
PRIMARY CAT	EDB-250902
ABSTRACT	THE AUTHOR GIVES A REVIEW ON THE TECHNICAL STATE IN LEAD TRACTION BATTERIES ACHIEVED SO FAR AND ON THE PROSPECTS FOR FURTHER IMPROVEMENTS. THE CELL AND BATTERY TRAY STANDARDS ARE COMPILED. DATA AND INFORMATION ON POWER DENSITY, LIFETIME, CHARGING TECHNIQUE AND MAINTENANCE ARE GIVEN. THE PRACTICALLY ACHIEVABLE LIMIT FOR THE POWER DENSITY IS ABOUT 35-40 WH/KG. FULL MAINTENANCE IS NOT POSSIBLE WITHOUT ADDITIONAL EQUIPMENT. CLOSED ELECTROLYTE-TIGHT PLASTIC VESSELS, WELDED PLASTIC LIDS AND COMPLETELY SEALED-OFF POLES RESULT IN BATTERIES THAT ARE EXTERIORLY COMPLETELY DRY AND POSSESS THEREFORE AN EXCELLENT INSULATION RESISTANCE. ADDITIONAL EQUIPMENT SUCH AS A CENTRAL WATER RE-FILLING SYSTEM OR GAS DRYING STOPPERS HAVE BEEN DEVELOPED BY VARTA AND ARE NOW BEING PRACTICALLY TESTED.
DESCRIPTORS	BATTERY CHARGERS;BATTERY CHARGING;ECONOMICS;ELECTRIC POWER; ELECTRIC-POWERED VEHICLES: T2;LEAD-ACID BATTERIES: T1,Q2; MAINTENANCE;PERFORMANCE: Q1;POWER DENSITY;REVIEWS: Q1;SERVICE LIFE;STANDARDS

B-55

ACCESSION NO.	79J0025372
TITLE	PERSPECTIVES FOR FUTURE TRACTION BATTERIES
AUTHORS	SCHWARTZ
AUTHOR AFF	VARTA BATTERIE A.G., KELKHEIM (GERMANY, F.R.). FORSCHUNGS- UND ENTWICKLUNGSZENTRUM
PUB DESC	VARTA SPEZ. REP., NO. 1, PP. 489-496
DATE	1977
LANGUAGE	IN GERMAN
CATEGORIES	EDB-250902;330300
PRIMARY CAT	EDB-250902
ABSTRACT	THE AUTHOR DISCUSSES THE FUTURE PROSPECTS OF THE BATTERY SYSTEMS PROPOSED FOR DRIVING VEHICLES. THE POWER DENSITY OF THE LEAD ACCUMULATOR CAN BE IMPROVED UPON BY INCREASED UTILIZATION OF MASS. IT IS ALSO POSSIBLE TO REDUCE THE MAINTENANCE EXPENDITURE BY USING A CATALYTIC WATER RECOMBINER OR BY A CENTRAL GAS ESCAPING AND WATER REFILLING SYSTEM. APPLICABLE LOW-TEMPERATURE ACCUMULATORS WITH ABOUT DOUBLE THE POWER DENSITY OF THE LEAD ACCUMULATOR ARE EXPECTED, PERHAPS FOR THE EIGHTIES. THERE ARE STILL CONSIDERABLE PROBLEMS YET TO BE SOLVED IN HIGH-TEMPERATURE ACCUMULATORS REGARDING OPERATIONAL BEHAVIOR LIFETIME AND SAFETY. THE FUEL CELL COULD SUBSTITUTE THE COMBUSTION MOTOR IN THE FAR FUTURE. IT IS, HOWEVER, MORE COMPLICATED AND THUS ALSO MORE EXPENSIVE THAN AN ACCUMULATOR.
DESCRIPTORS	COMPARATIVE EVALUATIONS;ECONOMICS;ELECTRIC BATTERIES: Q2,T3; ELECTRIC-POWERED VEHICLES: T2;ELECTROCHEMICAL CELLS; FORECASTING: Q3;FUEL CELLS;LEAD-ACID BATTERIES: T1,Q2; MAINTENANCE;PERFORMANCE: Q1;RECOMBINATION;WATER

B-56

ACCESSION NO.	79C0019796
TITLE(MONO)	SODIUM--SULFUR BATTERY FOR PEAK-LOAD COMPENSATION
EDITOR OR COMP	FISCHER, W.; SCHOEFFEL, H.
CORPORATE AUTH	BROWN, BOVERI UND CIE A.G., HEIDELBERG (GERMANY, F.R.)
SEC REPT NO	CONF-7804102--2
PAGE NO	19
AVAILABILITY	DEP. NTIS (US SALES ONLY), PC A02/MF A01.
CONF TITLE	SYSTEMS EXHIBITION ENERGY WITHIN THE CONTEXT OF THE HANNOVER FAIR
CONF PLACE	HANNOVER, F.R. GERMANY
CONF DATE	19 APR 1978
DATE	1978
LANGUAGE	IN GERMAN
CATEGORIES	EDB-250902;250904;200107;130700
PRIMARY CAT	EDB-250902

REPORT NO AED-CONF--76-155-039
ABSTRACT THE PRINCIPLE AND THE PRESENT STATE OF DEVELOPMENT OF THE SODIUM--SULFUR BATTERY ARE SURVEYED. AN ASSESSMENT OF WHETHER BATTERIES OF THIS KIND, AS A SUPPLEMENT FOR PUMPED-STORAGE POWER STATIONS AND GAS TURBINES, ARE TECHNICALLY AND ECONOMICALLY FEASIBLE FOR BALANCING OUT PEAK LOADS IS MADE. 10 FIGURES, 2 TABLES.
DESCRIPTORS DESIGN;ECONOMICS;ENERGY STORAGE SYSTEMS: 03,04;FEASIBILITY STUDIES;FOSSIL-FUEL POWER PLANTS: T4;GAS TURBINES;OFF-PEAK ENERGY STORAGE: T1;PERFORMANCE;PLANNING;PUMPED STORAGE POWER PLANTS: 13;REVIEWS: 02;SODIUM-SULFUR BATTERIES: 01,T2; TECHNOLOGYASSESSMENT

B-57

ACCESSION NO. 79C0019795
TITLE DESIGN OF A LITHIUM/SULFUR BATTERY FOR LOAD LEVELING ON UTILITY NETWORKS
AUTHORS IVINS, R.O.; CHILENSKAS, A.A.; KOLBA, V.M.; TOWLE, W.L.; NELSON, P.A.
AUTHOR AFF ARGONNE NATIONAL LAB., IL
TITLE(MONO) PROCEEDINGS OF 1975 IEEE SOUTHEASTCON REGION 3 CONFERENCE. VOLUME 1. ELECTRICITY: AN EXPANDING TECHNOLOGY
SEC REPT NO CONF-750405--P1
PAGE NO 30.2.1-30.2.9
CONF TITLE IEEE SOUTHEASTCON
CONF PLACE CHARLOTTE, NC, USA
CONF DATE 7 APR 1975
PUBL LOC INST. OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC., NEW YORK
DATE 1975
CATEGORIES EDB-250901;260107
PRIMARY CAT EDB-250901
AUGMENTATION 1. CM-DIA, 150-AH CELLS OPERATING AT 400 TO 450$SUP 0$C WITH 150 WH/KG, GROUPED TO FORM 1000 V SYSTEM
ABSTRACT A BATTERY OF LITHIUM--ALUMINUM/LICL--KCL/FERROUS SULFIDE (FES) CELLS HAS BEEN DESIGNED FOR TESTING IN THE BATTERY ENERGY STORAGE TEST (BEST) FACILITY. THE BATTERY DESIGN PROVIDES STORAGE OF 10 MWH WITH A 7-H CHARGE AND 10-H DISCHARGE, AS SPECIFIED FOR THE BEST FACILITY. THE CELL DESIGN IS BASED ON ANL ENGINEERING-SCALE CELLS (13-CM-DIA, 150 AH), OPERATED AT 400--450$SUP 0$C, WHICH HAVE DEMONSTRATED SPECIFIC ENERGIES GREATER THAN 150 WH/KG. CELLS HAVING FES$SUB 2$ POSITIVE ELECTRODES WITH MOLYBDENUM CURRENT COLLECTORS AND CELLS HAVING FES POSITIVE ELECTRODES WITH IRON CURRENT COLLECTORS ARE BEING DEVELOPED. THE CELL DESIGN AND COST ESTIMATES MADE IN THIS STUDY HAVE ASSUMED THE USE OF FES ELECTRODES AND IRON CURRENT COLLECTORS. HERMETICALLY SEALED, MULTIPLE-PARALLEL-PLATE SUBMODULES CAPABLE OF 1000-A DISCHARGES HAVE BEEN DESIGNED. ARRAYS OF THESE SUBMODULES ARE ARRANGED IN SERIES TO PROVIDE A NOMINAL 1000-V BATTERY SYSTEM. PERFORMANCE CHARACTERISTICS BASED ON ACTUAL CELL DATA HAVE BEEN CALCULATED FOR AN AIR-COOLED BATTERY SYSTEM. ENGINEERING CALCULATIONS HAVE INCLUDED CELL AND SUBMODULE TEMPERATURE DISTRIBUTIONS. HEAT TRANSFER AND POWER REQUIREMENTS WERE ALSO DETERMINED TO SIZE DUCTS AND BLOWER. VARIOUS VERSIONS OF FULL-SCALE CELLS OF THE LITHIUM--ALUMINUM/IRON SULFIDE SYSTEM ARE BEING DESIGNED FOR ORDER FROM COMMERCIAL SUPPLIERS. MATERIAL AND MANUFACTURING COSTS WERE ESTIMATED FOR THESE CELLS. PROCESS FLOWSHEETS AS WELL AS PLANT AND EQUIPMENT LAYOUTS WERE DEVELOPED, AND EQUIPMENT SIZES AND MANPOWER LEVELS WERE DETERMINED AS A BASIS FOR ESTIMATING MANUFACTURING COSTS. THE SELLING PRICE OF $27/KWH WAS ESTIMATED FOR BATTERY SUBMODULES BASED ON A PLANT CAPABLE OF PRODUCING 5000 0.92-KWH CELLS PER DAY. THIS INCLUDES A 25% RETURN ON INVESTMENT BEFORE TAXES. 6 FIGURES, 8 TABLES.
DESCRIPTORS ALUMINIUM ALLOYS;COST: Q1;DESIGN: Q1;HIGH TEMPERATURE;IRON SULFIDES;LITHIUM ALLOYS;LITHIUM CHLORIDES;LITHIUM-SULFUR BATTERIES: M1,Q2;OFF-PEAK ENERGY STORAGE: M2;PERFORMANCE; POTASSIUM CHLORIDES;PYRITE;SPECIFICATIONS

B-58

ACCESSION NO. 79C0019792
TITLE(MONO) COMMERCIALIZATION PLANNING FOR THE LITHIUM/METAL SULFIDE BATTERY
EDITOR OR COMP CHILENSKAS, A.A.
CORPORATE AUTH ARGONNE NATIONAL LAB., IL (USA)
PAGE NO 17

AVAILABILITY	DEP. NTIS, PC A02/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
CONF TITLE	SYMPOSIUM ON LITHIUM NEEDS AND RESOURCES
CONF PLACE	CORNING, NY, USA
CONF DATE	12 OCT 1977
DATE	1977
CATEGORIES	EDB-250901
PRIMARY CAT	EDB-250901
REPORT NO	CONF-771017--1
ABSTRACT	A FEDERALLY SUPPORTED BATTERY DEVELOPMENT PROGRAM HAS BEEN UNDERWAY AT ARGONNE NATIONAL LABORATORY SINCE 1973 THAT IS DIRECTED TO THE DEVELOPMENT AND COMMERCIALIZATION OF HIGH-ENERGY BATTERIES THAT MEET NATIONAL NEEDS. THIS PROGRAM HAS RECEIVED A HIGH NATIONAL PRIORITY FROM THE ENERGY RESEARCH DEVELOPMENT ADMINISTRATION (AND PREVIOUSLY THE ATOMIC ENERGY COMMISSION) WITH APPROPRIATE R AND D FUNDING BECAUSE ACHIEVEMENT OF THE PROGRAM GOALS IS PERCEIVED AS HAVING A POTENTIALLY IMPORTANT IMPACT UPON THE ENERGY RESOURCES IN THE U.S. THE COMMERCIAL PRODUCTION OF HIGH-ENERGY-DENSITY BATTERIES, IF PRODUCED AT COSTS THAT ARE ATTRACTIVE, CAN RESULT IN THE REDUCTION OF PETROLEUM CONSUMPTION IN APPLICATIONS SUCH AS UTILITY PEAK-SHAVING OR PERSONAL TRANSPORTATION. THIS WOULD BE ACCOMPLISHED BY SHIFTING THESE APPLICATIONS AWAY FROM PETROLEUM-FUELED COMBUSTION TURBINES AND INTERNAL COMBUSTION ENGINES TO BATTERY PEAKING PLANTS FOR UTILITIES AND BATTERY-POWERED AUTOMOBILES WHICH CAN USE ELECTRICITY PRODUCED FROM ENERGY SOURCES SUCH AS COAL OR NUCLEAR FUEL. THE ENERGY STORAGE THAT IS PROJECTED FOR MATURE LITHIUM/METAL SULFIDE (LI/MS) BATTERIES IS ABOUT 4 TO 5 TIMES THAT OF TODAY'S LEAD--ACID BATTERY PER UNIT WEIGHT AND ABOUT 3 TO 4 TIMES PER UNIT VOLUME. ACHIEVEMENT OF THESE PERFORMANCE GOALS AND THE COST GOALS FOR THE CELLS OF $20 TO $35/KWH WOULD MAKE THIS SYSTEM VERY ATTRACTIVE FOR MANY APPLICATIONS OF COMMERCIAL INTEREST. 4 FIGURES, 5 TABLES.
DESCRIPTORS	ALUMINIUM ALLOYS;AUTOMOBILES;COMMERCIALIZATION: Q1;COST; ELECTRIC-POWERED VEHICLES: T3;LITHIUM ALLOYS;LITHIUM-SULFUR BATTERIES: T1,Q2,Q3;MARKET;MATERIALS;OFF-PEAK ENERGY STORAGE: T2;PLANNING;SULFIDES;TECHNOLOGY TRANSFER;TRUCKS

B-59

ACCESSION NO.	79X0019764
TITLE(MONO)	HIGH-PERFORMANCE BATTERIES FOR STATIONARY ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT, JANUARY--MARCH 1978
EDITOR OR COMP	NELSON, P.A.
CORPORATE AUTH	ARGONNE NATIONAL LAB., IL (USA)
PAGE NO	84
AVAILABILITY	DEP. NTIS, PC A05/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
DATE	JUL 1978
CATEGORIES	EDB-250901
PRIMARY CAT	EDB-250901
REPORT NO	ANL--78-45
ABSTRACT	THIS REPORT COVERS RESEARCH, DEVELOPMENT, AND MANAGEMENT ACTIVITIES ON LITHIUM/METAL SULFIDE BATTERIES DURING JANUARY--MARCH 1978. THESE BATTERIES ARE BEING DEVELOPED FOR ELECTRIC-VEHICLE PROPULSION AND FOR STATIONARY ENERGY STORAGE APPLICATIONS. THE PRESENT CELLS, WHICH OPERATE AT 400 TO 500$SUP 0$C, ARE OF A VERTICALLY ORIENTED, PRISMATIC DESIGN WITH ONE OR MORE POSITIVE ELECTRODES OF METAL SULFIDE (USUALLY, FES OR FE$SUB 2$), FACED ON BOTH SIDES BY NEGATIVE ELECTRODES OF LITHIUM-ALUMINUM OR LITHIUM-SILICON ALLOY. THE ELECTROLYTE IS MOLTEN LICL-KCL EUTECTIC (M.P., 352$SUP 0$C). AN IMPORTANT ADVANCE IN CELL DESIGN WAS THE SUCCESSFUL DEVELOPMENT OF MULTIPLE-ELECTRODE CELLS, WHICH HAVE HIGHER SPECIFIC ENERGY AND SPECIFIC POWER THAN THE EARLIER BICELL (ONE POSITIVE ELECTRODE) DESIGNS. A MAJOR OBJECTIVE OF THIS PROGRAM IS TO TRANSFER THE TECHNOLOGY TO INDUSTRY AS IT IS DEVELOPED. THE MOST SIGNIFICANT EVENT DURING THIS PERIOD WAS THE INITIATION OF AN EFFORT TO DESIGN, DEVELOP, AND FABRICATE A 40-KWH ELECTRIC-VEHICLE BATTERY (MARK IA). THE MARK IA IS SCHEDULED FOR TESTING IN A VAN EARLY IN 1979. CONCEPTUAL DESIGN STUDIES OF A 100 MWH ENERGY-STORAGE PLANT ARE UNDER WAY. IN-HOUSE EFFORTS CONTINUED ON CELL AND BATTERY DEVELOPMENT, MATERIALS DEVELOPMENT AND

	EVALUATION, CELL-CHEMISTRY INVESTIGATIONS, BATTERY DESIGN AND COMMERCIALIZATION STUDIES, AND THE DEVELOPMENT OF ADVANCED, HIGH-TEMPERATURE BATTERIES THAT USE INEXPENSIVE, ABUNDANT MATERIALS. 16 FIGURES, 26 TABLES.
DESCRIPTORS	ALUMINIUM ALLOYS;COMMERCIALIZATION;DESIGN;ELECTRIC-POWERED VEHICLES: T2;ELECTROCHEMISTRY;HIGH TEMPERATURE;IRON SULFIDES; LITHIUM ALLOYS;LITHIUM CHLORIDES;LITHIUM-SULFUR BATTERIES: T3,Q1,Q2;MATERIALS;OFF-PEAK ENERGY STORAGE: T1;POTASSIUM CHLORIDES;PYRITE;RESEARCH PROGRAMS: Q3;SILICON ALLOYS; TECHNOLOGY TRANSFER

B-60

ACCESSION NO.	79C0011121
REPORT NO.PAGE	CONF-770865 PP. 655-666
TITLE	BATTERY STORAGE PERFORMANCE REQUIREMENTS FOR TERRESTRIAL SOLAR PHOTOVOLTAIC POWER SYSTEMS
AUTHORS	STOLTE, W.J.
AUTHOR AFF	BECHTEL CORP., SAN FRANCISCO
TITLE(MONO)	PROCEEDINGS OF THE SEMIANNUAL REVIEW MEETING, SILICON TECHNOLOGY PROGRAMS BRANCH
PAGE NO	655-666
CONF TITLE	SEMIANNUAL REVIEW MEETING ON SILICON TECHNOLOGY
CONF PLACE	WILLIAMSBURG, VA, USA
CONF DATE	23 AUG 1977
DATE	DEC 1977
CATEGORIES	EDB-140501;140600;250902
PRIMARY CAT	EDB-140501
REPORT NO	CONF-770865--
ABSTRACT	NONE
DESCRIPTORS	COMMERCIAL BUILDINGS;ECONOMICS;EFFICIENCY;ELECTRIC BATTERIES: T3;ELECTRIC UTILITIES;ENERGY STORAGE: Q1,Q2;LIFE-CYCLE COST; PERFORMANCE: Q3;PHOTOVOLTAIC POWER PLANTS: T2;RESIDENTIAL BUILDINGS;SERVICE LIFE;SOLAR CELL ARRAYS: T1

B-61

ACCESSION NO.	79J0006614
TITLE	SOVIET PUSHING ELECTROCHEMICAL POWER FOR VEHICLES
AUTHORS	BUSI, J.D.
AUTHOR AFF	ARMY FOREIGN SCIENCE AND TECH. CENTER, CHARLOTTESVILLE, VA
PUB DESC	ARMY RD AND A, V. 19, NO. 2, PP. 12-13
DATE	1978
CATEGORIES	EDB-330300;250901;300500
PRIMARY CAT	EDB-330300
ABSTRACT	THE BASIC NEED IN DEVELOPING PRACTICAL ALL-ELECTRIC VEHICLES FOR URBAN TRANSIT WITHIN THE USSR IS THE DEVELOPMENT OF ADEQUATE ELECTROCHEMICAL POWER SOURCES. THESE SOURCES MUST BE RELIABLE, CORRESPOND TO ESTABLISHED SOVIET INDUSTRIAL AND AUTOMOTIVE STANDARDS, AND SATISFY PREDETERMINED DRIVING AND CLIMATIC SPECIFICATIONS. THREE TYPES OF ELECTROCHEMICAL POWER SOURCES BEING CONSIDERED IN THE USSR ARE DISCUSSED. CONVENTIONAL LEAD-ACID AND ALKALINE-TYPE STORAGE BATTERIES; ELECTROCHEMICAL FUEL CELLS; AND ADVANCED, UNCONVENTIONAL, HIGH-ENERGY-TYPE TRACTION BATTERIES ARE DISCUSSED. THE SOVIETS INITIALLY STRESSED THE DEVELOPMENT OF LEAD-ACID TRACTION BATTERIES FOR ALL-ELECTRIC VEHICLES, BUT AFTER FINDING THEIR DRAWBACKS TO BE LOW-ENERGY DENSITY AND POOR LOW-TEMPERATURE CHARGE/DISCHARGE CHARACTERISTICS, THEY SHIFTED THEIR TRACTION BATTERY RESEARCH EFFORT TO ALKALINE SYSTEMS. THE DEVELOPMENT OF ALKALINE TRACTION BATTERIES SATISFIES BOTH DRIVING RANGE AND LOW-TEMPERATURE REQUIREMENTS. THE SOVIETS HAVE INVESTIGATED AND DEMONSTRATED FUEL CELLS FOR ELECTRIC GROUND-PROPULSION APPLICATIONS, ESTABLISHED AN EXTENSIVE THEORETICAL AND FUNDAMENTAL DATA BASE, BUT HAVE NOT PROGRESSED BEYOND THE ADVANCED DEVELOPMENT STAGE. THEY HAVE CONDUCTED BASIC RESEARCH AND LIMITED EXPLORATORY DEVELOPMENT OF UNCONVENTIONAL HIGH ENERGY BATTERY SYSTEMS. THESE BATTERIES COUPLE STRONG ALKALINE EARTH METALS AS ANODES AND STRONG OXIDANTS SUCH AS HALOGENS OR CHALCOGENS AS CATHODES. AN ANALYSIS OF ALL THESE POTENTIAL ELECTROCHEMICAL COUPLES HAS RESULTED IN THE SODIUM-SULFUR, AND LITHIUM-SULFUR BATTERY SYSTEMS AS THE MOST PROMISING UNCONVENTIONAL, HIGH-ENERGY BATTERY TYPES FOR FUTURE (BEYOND 1985) ELECTRIC VEHICLE APPLICATIONS.
DESCRIPTORS	COMMERCIALIZATION;COST;ELECTRIC BATTERIES: T2,Q3; ELECTRIC-POWERED VEHICLES: T3;ELECTROCHEMISTRY;ENERGY

	CONSUMPTION;EVALUATION;FUEL CELLS: 03;LEAD-ACID BATTERIES; LITHIUM-SULFUR BATTERIES;NICKEL-ZINC BATTERIES;PERFORMANCE; PRODUCTION;RESEARCH PROGRAMS;SODIUM-SULFUR BATTERIES; SPECIFICATIONS: 02;URBAN AREAS;USSR

B-62

ACCESSION NO.	79J0008446
TITLE	SODIUM--SULPHUR CELLS
AUTHORS	FOULKES, F.R.; CHOI, P.T.
AUTHOR AFF	UNIV. OF TORONTO
PUB DESC	CAN. J. CHEM. ENG., V. 56, NO. 2, PP. 236-245
DATE	APR 1978
CATEGORIES	EDB-250902
PRIMARY CAT	EDB-250902
AUGMENTATION	50 W/KG, 250 WH/KG
ABSTRACT	THE SODIUM--SULFUR BATTERY IS REVIEWED AND EXPERIMENTAL RESULTS ARE PRESENTED. THE EXPERIMENTAL CELLS WERE CAPABLE OF DELIVERING STEADY-STATE POWER DENSITIES AS HIGH AS 50 W KG$SUP -1$ AND ENERGY DENSITIES AS HIGH AS 250 WH KG$SUP -1$. THE THEORETICAL OPEN CIRCUIT VOLTAGE OF 2.06 V WAS OBSERVED IN ALL CASES. CELL POLARIZATION WAS LIMITED BY CELL INTERNAL RESISTANCE, WHICH WAS ATTRIBUTED LARGELY TO THE RESISTANCE OF THE $BETA$-ALUMINA ELECTROLYTE. THE ''ASYMMETRY EFFECT'' IS EXPLAINED IN TERMS OF AN ELECTRODE BLOCKAGE MECHANISM INVOLVING POLYSULFIDES. THE SODIUM--SULFUR BATTERY APPEARS TO BE TECHNICALLY FEASIBLE AS THE POWER SOURCE FOR AN ALL-ELECTRIC VEHICLE. 5 FIGURES, 5 TABLES, 150 REFERENCES.
DESCRIPTORS	DESIGN;ELECTRIC-POWERED VEHICLES: T2;ELECTRODES;ELECTROLYTES; HIGH TEMPERATURE;PERFORMANCE: 01;POLARIZATION;POWER DENSITY; REVIEWS;SODIUM-SULFUR BATTERIES: M1,Q2

B-63

ACCESSION NO.	79C0008445
TITLE(MONO)	REVIEW OF INDUSTRIAL PARTICIPATION IN THE ANL LITHIUM/IRON SULFIDE BATTERY DEVELOPMENT PROGRAM
EDITOR OR COMP	GAY, E.C.; MILLER, W.E.; MALECHA, R.F.; ELLIOTT, R.C.
CORPORATE AUTH	ARGONNE NATIONAL LAB., IL (USA)
PAGE NO	26
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT W-31-109-ENG-38
CONF TITLE	13. IECEC CONFERENCE OF THE SOCIETY OF AUTOMOTIVE ENGINEERS
CONF PLACE	DETROIT, MI, USA
CONF DATE	20 AUG 1976
DATE	1976
CATEGORIES	EDB-250901;290700
PRIMARY CAT	EDB-250901
REPORT NO	CONF-780852--1
ABSTRACT	LITHIUM/IRON SULFIDE BATTERIES ARE BEING DEVELOPED AT ARGONNE NATIONAL LABORATORY (ANL) FOR USE AS POWER SOURCES FOR ELECTRIC VEHICLES AND FOR STATIONARY ENERGY STORAGE DEVICES FOR LOAD LEVELING. AN IMPORTANT PART OF THE BATTERY PROGRAM INVOLVES SUBCONTRACTS WITH VARIOUS INDUSTRIAL FIRMS. THE OBJECTIVES OF THE INDUSTRIAL SUBCONTRACTS ARE TO TRANSFER THE ANL TECHNOLOGY TO INDUSTRY, AUGMENT THE CELL AND BATTERY DEVELOPMENT CONDUCTED AT ANL, DEVELOP SOURCES FOR MATERIALS AND COMPONENTS, DEVELOP FABRICATION PROCEDURES, AND FABRICATE TEST CELLS AND BATTERIES. THIS PAPER DESCRIBES THE NATURE OF THE INDUSTRIAL PARTICIPATION IN THE ANL BATTERY PROGRAM AND THE PROGRESS THAT HAS BEEN MADE IN THE DEVELOPMENT AND FABRICATION OF INDUSTRIAL CELLS. EARLY IN 1975, ANL INITIATED CELL DEVELOPMENT AND FABRICATION CONTRACTS. SINCE THE INITIATION OF CELL FABRICATION BY THE INDUSTRIAL FIRMS, ANL HAS FABRICATED ONLY SMALL RESEARCH CELLS AND ENGINEERING CELLS WITH UNIQUE FEATURES. IN ORDER TO EVALUATE PROGRESS IN THE DEVELOPMENT OF CELLS FABRICATED BY INDUSTRIAL SUBCONTRACTORS, ANL HAS USED AUTOMATED QUALIFICATION TESTING. INDUSTRIAL CELLS THAT CONTAINED FE$SUB 2$ IN THE POSITIVE ELECTRODE HAVE ACHIEVED A SPECIFIC ENERGY OF 100 WH/KG AT A 4-H DISCHARGE RATE AND A PEAK POWER OF 100 W/KG. SOME OF THESE CELLS HAVE SHOWN GOOD PERFORMANCE FOR UP TO 300 DEEP DISCHARGE CYCLES. INDUSTRIAL CELLS THAT CONTAINED FES IN THE POSITIVE ELECTRODE HAVE MAINTAINED GOOD PERFORMANCE THROUGH 1000 DEEP DISCHARGE CYCLES. PRESENT CELL DEVELOPMENT EFFORTS ARE DIRECTED TOWARD IMPROVING SPECIFIC ENERGY AND POWER IN THE CELLS THAT CONTAIN FES AND IMPROVING CYCLE LIFE IN CELLS THAT

CONTAIN FESSSUB 28. IN 1976, ANL INITIATED A CONTRACT FOR THE DEVELOPMENT OF A FULL-SCALE ELECTRIC VEHICLE BATTERY. 6 FIGURES, 3 TABLES.

DESCRIPTORS — ALUMINIUM ALLOYS;ANL;ELECTRIC-POWERED VEHICLES: T2;FABRICATION: Q1;IRON SULFIDES;LITHIUM ALLOYS;LITHIUM-SULFUR BATTERIES: T1,Q2,Q3;OFF-PEAK ENERGY STORAGE: T3;PERFORMANCE TESTING; RESEARCH PROGRAMS;TECHNOLOGY TRANSFER: Q1

B-64

ACCESSION NO. — 79C0002773
TITLE(MONO) — ADVANCED LEAD--ACID ELECTRIC VEHICLE BATTERIES: DON'T SELL THIS SYSTEM SHORT. PAPER NO. 7741
EDITOR OR COMP — WEINLEIN, C.L.; PIERSON, J.R.
CORPORATE AUTH — GLOBE-UNION, INC., MILWAUKEE, WI (USA)
PAGE NO — 6
AVAILABILITY — ELECTRIC VEHICLE COUNCIL, NEW YORK, NY $1.00.
CONF TITLE — ELECTRIC VEHICLE EXPOSITION AND CONFERENCE
CONF PLACE — CHICAGO, IL, USA
CONF DATE — 26 APR 1977
DATE — 1977
CATEGORIES — EDB-330300;250901
PRIMARY CAT — EDB-330300
REPORT NO — CONF-770468--22
ABSTRACT — A HISTORICAL REVIEW IS GIVEN OF THE DEVELOPMENT OF LEAD--ACID BATTERIES IN VIEW OF THEIR POSSIBLE USE IN ELECTRIC VEHICLES. THE SEVENTIES HAVE WITNESSED A MULTITUDE OF DEVELOPMENTS. COMPUTER DESIGN PROGRAMS HAVE BEEN DEVELOPED TO INSURE UNIFORM, OPTIMUM UTILIZATION OF ACTIVE MATERIALS AND GRID METAL. IMPROVEMENTS IN GRID MANUFACTURING TECHNIQUES HAVE ALLOWED THE USE OF DESIGNS WHICH REDUCE WEIGHT AND IMPROVE PERFORMANCE. GRID ALLOY AND ACTIVE MATERIAL CONSTITUENTS HAVE BEEN THE SUBJECT OF INTENSIVE INVESTIGATION AND OPTIMIZATION. THIS HAS LED TO THE INTRODUCTION OF ALLOYS WHICH HAVE BETTER ELECTRICAL CONDUCTIVITY AND REDUCE WATER LOSS AS WELL AS ACTIVE MATERIAL FORMULATIONS WHICH PRODUCE GREATER COULOMBIC EFFICIENCY.
DESCRIPTORS — DESIGN;ELECTRIC-POWERED VEHICLES: T1;LEAD-ACID BATTERIES: T2,Q1; MATERIALS;REVIEWS;TECHNOLOGY ASSESSMENT: Q2

B-65

ACCESSION NO. — 79J0002278
TITLE — MATERIALS REQUIREMENTS FOR HIGH PERFORMANCE SECONDARY BATTERIES
AUTHORS — BATTLES, J.E.; SMAGA, J.A.; MYLES, K.M.
AUTHOR AFF — ARGONNE NATIONAL LAB., IL
PUB DESC — METALL. TRANS., A, V. 9, PP. 183-191
DATE — FEB 1978
CATEGORIES — EDB-250903
PRIMARY CAT — EDB-250903
ABSTRACT — A REVIEW IS PRESENTED OF THE MATERIALS PROBLEMS IN SECONDARY BATTERY SYSTEMS THAT SHOW PROMISE FOR USE AS POWER SOURCES FOR VEHICLE PROPULSION AND AS STATIONARY ENERGY STORAGE DEVICES FOR UTILITY APPLICATION. MATERIALS FOR AMBIENT-TEMPERATURE BATTERIES ARE REVIEWED BRIEFLY, AND THOSE FOR TWO ADVANCED SYSTEMS, SODIUM/SULFUR AND LITHIUM/METAL SULFIDE, ARE DESCRIBED MORE FULLY. IN BOTH SYSTEMS, THE SEVERE CORROSIVENESS OF THE CELL ENVIRONMENT, THE HIGH TEMPERATURE OF OPERATION, AND THE REQUIREMENTS OF LOW COST AND WEIGHT PLACE DEMAND RESTRICTIONS ON MATERIALS OF CONSTRUCTION. MATERIALS DEVELOPMENT EFFORTS IN ARGONNE NATIONAL LABORATORY'S LITHIUM/METAL SULFIDE BATTERY PROGRAM ARE DISCUSSED IN TERMS OF THE INDIVIDUAL CELL COMPONENTS (ELECTRICAL FEEDTHROUGHS, ELECTRODE SEPARATORS, ELECTRODE CURRENT COLLECTORS, AND CELL HOUSINGS). THE MATERIALS SELECTION PROCESS IS DESCRIBED. EXPERIMENTAL DATA ON COMPATIBILITY TESTS ARE PRESENTED, AND THE CURRENT STATUS OF THE MATERIALS DEVELOPMENT EFFORT IS SUMMARIZED. 5 FIGURES, 7 TABLES.
DESCRIPTORS — ELECTRIC BATTERIES: Q1,Q2,T5;ELECTRIC-POWERED VEHICLES: T1; MATERIALS: Q3,Q4,Q5;OFF-PEAK ENERGY STORAGE: T2;TESTING
SPLITS

AMBIENT TEMPERATURE;IRON-AIR BATTERIES;IRON-NICKEL BATTERIES; LEAD-ACID BATTERIES;NICKEL-ZINC BATTERIES;PERFORMANCE;ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES

CORROSION;HIGH TEMPERATURE;SODIUM-SULFUR BATTERIES: T3

	BATTERY SEPARATORS;CONNECTORS;CONTAINERS;CORROSION;HIGH TEMPERATURE;LITHIUM-SULFUR BATTERIES: T4;SULFIDES

B-66

99/5/0000039-00001187/	104
ACCESSION NO.	79J0002274
TITLE	LEAD BATTERY MATERIALS OF THE FUTURE - POSSIBILITIES AND TRENDS
AUTHORS	HEUBNER, U.
AUTHOR AFF	METALLGESELLSCHAFT A.G., FRANKFURT AM MAIN (GERMANY, F.R.). METALL-LABORATORIUM
PUB DESC	METALL, V. 32, NO. 5, PP. 462-466
DATE	MAY 1978
LANGUAGE	IN GERMAN
CATEGORIES	EDB-250903
PRIMARY CAT	EDB-250903
ABSTRACT	WHEREAS PURE LEAD CONTINUES TO BE FOR THE MANUFACTURE OF THE ACTIVE MASS, LEAD BATTERY ALLOYS HAVE FOR SOME TIME BEEN UNDERGOING A FUNDAMENTAL CHANGE AIMED AT MAKING RAW MATERIALS CHEAPER, REDUCING SELF-DISCHARGE AND MAINTENANCE OF THE BATTERIES, INCREASING ENERGY DENSITY AND IMPROVING ELECTRICAL CONDUCTIVITY. POSSIBILITIES FOR SUCH A CHANGE INCLUDE THE REDUCTION OF THE ANTIMONY CONTENT AS WELL AS THE INTRODUCTION OF SB-FREE ALLOYS AND COMPOSITE MATERIALS. DEVELOPMENT SHOWS A TENDENCY TOWARD LOW ALLOY LEAD-ANTIMONY MATERIALS WITH ADDITIONS OF ARSENIC, SELENIUM OR SULFUR, COPPER AND TIN, AND ALSO TOWARD LEAD-CALCIUM-TIN AND, POSSIBLY, LEAD-STRONTIUM-TIN ALLOYS. COMPOSITE MATERIALS, E.G., LEAD WITH AN ALUMINIUM CORE, ARE BEING DEVELOPED FOR THE USE IN TRACTION BATTERIES.
DESCRIPTORS	ALLOY SYSTEMS;ANTIMONY ALLOYS;ARSENIC ADDITIONS;CALCIUM ALLOYS; COMPOSITE MATERIALS;ELECTRIC-POWERED VEHICLES: T2;ELECTRODES: Q1;LEAD BASE ALLOYS;LEAD-ACID BATTERIES: T1,Q2;MATERIALS; REVIEWS;STRONTIUM ALLOYS;TIN ALLOYS

B-67

ACCESSION NO.	78R0116077
TITLE(MONO)	LEAD - 1977
EDITOR OR COMP	RYAN, J.P.; HAGUE, J.M.
CORPORATE AUTH	BUREAU OF MINES, WASHINGTON, DC (USA)
PAGE NO	28
DATE	DEC 1977
CATEGORIES	EDB-290400;250903
PRIMARY CAT	EDB-290400
REPORT NO	PB--277501
ABSTRACT	LEAD IS ONE OF THE MOST USEFUL AND ESSENTIAL METALS IN THE SERVICE OF MAN. ITS MAJOR USES ARE STORAGE BATTERIES FOR AUTOMOBILES AND BATTERY-POWERED VEHICLES, AS AN ANTIKNOCK ADDITIVE IN GASOLINE, AND IN MATERIALS FOR THE CONSTRUCTION INDUSTRY. THE UNITED STATES HAS THE LARGEST RESERVES OF LEAD AND HAS BEEN THE LEADING LEAD-PRODUCING COUNTRY FOR SEVERAL YEARS. THIS REPORT PRESENTS COMPREHENSIVE DATA FOR THE COMMODITY INCLUDING BACKGROUND MATERIAL ON INDUSTRY STRUCTURE, RESERVES AND RESOURCES, TECHNOLOGY, SUPPLY-DEMAND RELATIONSHIPS, BYPRODUCTS AND COPRODUCTS, STRATEGIC CONSIDERATIONS, ECONOMIC FACTORS AND PROBLEMS, ENVIRONMENTAL CONSIDERATIONS, OPERATING FACTORS AND PROBLEMS, AND OUTLOOK TO 2000.
DESCRIPTORS	ADDITIVES;AUTOMOBILES;ECONOMICS;ELECTRIC-POWERED VEHICLES; ENVIRONMENTAL IMPACTS;FORECASTING;GASOLINE;GOVERNMENT POLICIES; LEAD: T;LEAD-ACID BATTERIES: T1;MATERIALS: Q1;METAL INDUSTRY; MINERAL RESOURCES;MINING;REFINING;RESERVES;SMELTING

B-68

ACCESSION NO.	78R0102422
TITLE(MONO)	BATTERY AND ELECTROCHEMICAL SYSTEMS PROGRAM SUMMARY, FY 1977
EDITOR OR COMP	WEBSTER, W.H. (ED.)
CORPORATE AUTH	DEPARTMENT OF ENERGY, WASHINGTON, D.C. (USA). DIV. OF ENERGY STORAGE SYSTEMS
PAGE NO	156
AVAILABILITY	DEP. NTIS, PC A06/MF A01.
DATE	APR 1978
CATEGORIES	EDB-250900;400400
PRIMARY CAT	EDB-250900
REPORT NO	DOE/ET--0014
ABSTRACT	THE SUCCESS OF WIND AND PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

FOR RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL APPLICATIONS IS HIGHLY DEPENDENT ON THE DEVELOPMENT OF A COST-EFFECTIVE BATTERY STORAGE SYSTEM TO PROVIDE POWER DURING PERIODS OF NO WIND OR SUNLIGHT. THE USE OF 3 TO 9 MILLION ELECTRIC CARS BY THE YEAR 2000 WILL RESULT IN AN OIL SAVING FROM 35 TO 90 MILLION BARRELS PER YEAR. DURING FY 1977, STOR COMMITTED $13.3 MILLION OF ITS FUNDS TO THESE ELECTROCHEMICAL PROGRAMS, AND MANAGED AN ADDITIONAL $5.6 MILLION FOR THE DIVISION OF TRANSPORTATION ENERGY CONSERVATION TO DEVELOP NEAR-TERM BATTERIES FOR ELECTRIC VEHICLES. THIS PUBLICATION CONSISTS OF SUMMARIES OF ALL THESE PROGRAMS, INCLUDING CONTRACTORS, MAJOR SUBCONTRACTS, NAMES OF PROGRAM MANAGERS, FUNDING, AND A BRIEF DESCRIPTION OF THE OBJECTIVES AND STATUS OF EACH PROGRAM.

DESCRIPTORS — ELECTRIC BATTERIES: T1;ELECTRIC-POWERED VEHICLES;ENERGY STORAGE; IRON-AIR BATTERIES;IRON-NICKEL BATTERIES;LEAD-ACID BATTERIES; LITHIUM-SULFUR BATTERIES;NICKEL-ZINC BATTERIES;REDOX FUEL CELLS; RESEARCH PROGRAMS: Q1;SODIUM-SULFUR BATTERIES;US DOE; ZINC-CHLORINE BATTERIES

B-69

ACCESSION NO. — 78R0089915
TITLE(MONO) — DEVELOPMENT OF HIGH-EFFICIENCY COST-EFFECTIVE, ZINC--CHLORINE BATTERIES FOR UTILITY PEAK-SHAVING, 1976. INTERIM REPORT
EDITOR OR COMP — SYMONS, P.C.
CORPORATE AUTH — ENERGY DEVELOPMENT ASSOCIATES, MADISON HEIGHTS, MICH. (USA)
PAGE NO — 277
AVAILABILITY — DEP. NTIS, PC A13/MF A01.
DATE — MAR 1978
CATEGORIES — EDB-250901
PRIMARY CAT — EDB-250901
REPORT NO — EPRI-EM--711
ABSTRACT — THE TWO PRINCIPAL THRUSTS OF THIS PROGRAM WERE BATTERY SCALE-UP BY A FACTOR OF TWENTY FROM EARLIER WORK AND INVESTIGATION OF THE ECONOMICS OF ZINC--CHLORINE PEAK-SHAVING BATTERIES LOCATED AT UTILITY SUBSTATIONS. DEVELOPMENT PROGRAMS ON CELL PERFORMANCE, ELECTRODE RESEARCH, AND MATERIALS OF CONSTRUCTION WERE CONDUCTED IN SUPPORT OF THESE OBJECTIVES. A BATTERY WAS DESIGNED, BUILT, AND TESTED WHICH DELIVERED 16 KWH DC AT AN ELECTROCHEMICAL ENERGY EFFICIENCY OF 60 PERCENT. THIS SCALE-UP FROM A 1 KWH SYSTEM WAS SUCCESSFUL DESPITE DIFFICULTIES WITH EXCESSIVE HYDROGEN EVOLUTION AND ZINC DENDRITE FORMATION DURING INITIAL TESTING. TWO SMALLER SYSTEMS WERE BUILT AND TESTED IN ORDER TO PERMIT INFORMED SELECTION OF THE CHLORINE-ELECTRODE MATERIAL. POROUS GRAPHITE WAS CHOSEN OVER RUTHENIA-CATALYZED POROUS TITANIUM BECAUSE OF CONSIDERATIONS OF ULTIMATE COST, EASE OF SYSTEM OPERABILITY, AND SYSTEM SAFETY. THE CYCLE-TESTING OF TWO BATTERY SYSTEMS WAS SUCCESSFULLY AUTOMATED. EXPERIENCE WITH THE AUTOMATION ACTIVITIES INDICATED THAT THE ZINC--CHLORINE BATTERY SYSTEM CAN OPERATE (CHARGE AND DISCHARGE) FOR EXTENDED PERIODS WITHOUT HUMAN INTERVENTION. TWO CONCEPTUAL DESIGNS--MARK 2 AND MARK 3--OF A 100-MWH (20-MW) ZINC--CHLORINE BATTERY PLANT WERE PREPARED. A DETAILED COST BREAKDOWN WAS PROVIDED FOR EACH DESIGN. IN A MATURE MARKET, THE SELLING PRICES OF THE MARK 2 AND MARK 3 PLANTS WOULD BE $25/KWH AND $21/KWH (1976$), RESPECTIVELY. THESE SELLING PRICES COUPLED WITH A 70 PERCENT AC TO AC STORAGE EFFICIENCY WOULD MAKE THE BATTERY PLANTS HIGHLY COMPETITIVE WITH FOSSIL FUEL-CONSUMING COMBUSTION TURBINES FROM AN ELECTRICITY-COST STANDPOINT. 102 FIGURES, 36 TABLES.
DESCRIPTORS — COST;DESIGN: Q1;ECONOMICS;ELECTRODES;MATERIALS;OFF-PEAK ENERGY STORAGE: T2;PERFORMANCE;ZINC-CHLORINE BATTERIES: T1,Q2

B-70 NONE

B-71

ACCESSION NO. — 78C0037158
TITLE — NA/S CELL AS A SOURCE OF MOTIVE POWER FOR ELECTRIC VEHICLES
AUTHORS — FISCHER, W. ; BAUKAL, W.
AUTHOR AFF — BROWN, BOVERI AND CO. AG, HEIDELBERG
TITLE(MONO) — FOURTH INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM. VOL. 2
PAGE NO — 20P, PAPER 32.6
CONF TITLE — 4. INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM
CONF PLACE — DUSSELDORF, F.R. GERMANY

CONF DATE	31 AUG 1976
PUBL LOC	ELECTRIC VEHICLE COUNCIL, NEW YORK
DATE	1976
LANGUAGE	IN GERMAN AND ENGLISH
DROP NOTE	SEE CONF-760666--P2
CATEGORIES	EDB-250901
PRIMARY CAT	EDB-250901
ABSTRACT	THE FUNDAMENTAL QUESTIONS CONCERNING THE SODIUM/SULFUR CELL USING BETA ALUMINIUM OXIDE AS SOLID ELECTROLYTE WERE CLARIFIED SOME YEARS AGO; EVEN SO, SOME PROBLEMS STILL REMAIN TO BE SOLVED BEFORE ITS USE IS POSSIBLE AS A TRACTION BATTERY. ONE OF THE PROBLEMS WHICH HAS HITHERTO BEEN ONLY PARTIALLY SOLVED LIES IN THE INCOMPLETE UTILIZATION OF THE SULFUR FOR THE ELECTROCHEMICAL REACTION. IN THE MEANTIME, A HIGHER DEGREE OF UTILIZATION HAS BEEN ACHIEVED BY EMPLOYING A SPECIAL GEOMETRY FOR THE CATHODE AND BY ADDITIVES TO THE SULFUR. CONSIDERABLE ADVANCES HAVE ALSO BEEN MADE REGARDING LONG-TERM PROPERTIES. SPECIFIC CHARGE THROUGHPUTS OF UP TO 2,300 AH/CM$SUP 2$ HAVE BEEN OBTAINED WITH THE SOLID ELECTROLYTES DEVELOPED. THE CHARGING DENSITIES REQUIRED TO PERMIT USE IN A TRACTION BATTERY ARE 500 TO 2,000 AH/CM$SUP 2$. MATERIALS HAVE BEEN DEVELOPED FOR THE CELL CASING WHICH EXHIBIT ONLY MINIMUM ATTACK BY CORROSION WHEN IN CONTACT WITH SULFUR AND SULFIDES AT 300$SUP 0$C. FROM THE EXPERIMENTS MADE IT CAN BE CONCLUDED THAT NA/S BATTERIES ARE CAPABLE OF REALIZATION FOR TRACTION PURPOSES IF IT BECOMES POSSIBLE TO IMPLEMENT THE DATA MEASURED ON LABORATORY CELLS IN INDUSTRIAL-SCALE CELLS. THE ENERGY AND POWER DENSITIES ANTICIPATED ARE HIGHER BY A FACTOR OF ROUGHLY 4 THAN THOSE FOR THE LEAD ACCUMULATOR. THE RESULTS OBTAINED HITHERTO INDICATE THAT, HOPEFULLY, SERVICE LIVES OF SEVERAL YEARS CAN BE ACHIEVED. 9 FIGURES, 3 TABLES.
DESCRIPTORS	ADDITIVES;ALUMINIUM OXIDES;CATHODES;CHEMICAL REACTIONS; CONTAINERS;DESIGN: Q2;EFFICIENCY;ELECTRIC-POWERED VEHICLES: T1; GEOMETRY;HIGH TEMPERATURE;MATERIALS;SAFETY;SERVICE LIFE; SODIUM-SULFUR BATTERIES: Q1,T2;SULFUR

B-72

ACCESSION NO.	78C0035646
TITLE(MONO)	PRELIMINARY DESIGN AND ANALYSIS OF RECOVERY OF LITHIUM FROM BRINE WITH THE USE OF A SELECTIVE EXTRACTANT
EDITOR OR COMP	DANG, V.D.; STEINBERG, M.
CORPORATE AUTH	BROOKHAVEN NATIONAL LAB., UPTON, N.Y. (USA)
SEC REPT NO	CONF-770570--1
PAGE NO	26
AVAILABILITY	DEP. NTIS, PC A03/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-0016
CONF TITLE	13. ANNUAL FORUM ON THE GEOLOGY OF INDUSTRIAL MINERALS
CONF PLACE	NORMAN, OK, USA
CONF DATE	12 MAY 1977
DATE	MAY 1977
CATEGORIES	EDB-060202;400105;250903
PRIMARY CAT	EDB-060202
REPORT NO	BNL--22824
ABSTRACT	LITHIUM REQUIREMENTS FOR BATTERY AND CONTROLLED THERMONUCLEAR FUSION REACTOR USES IN THE NEXT FEW DECADES MAY EXCEED THE CURRENT AVAILABILITY OF THE MINERAL AND BRINE RESERVES. IT IS THUS PRUDENT TO SEARCH FOR NEW RESERVES AND RESOURCES TO SATISFY THESE AND OTHER LITHIUM APPLICATIONS IN THE FUTURE. IT HAS BEEN REPORTED THAT THE LITHIUM CONTENT OF SMACKOVER OILFIELD WATERS RANGES IN ORDER OF 100--500 MG/L, AND THUS COULD REPRESENT A SUBSTANTIAL RESERVE. A METHOD IS PROPOSED TO EXTRACT LITHIUM FROM THIS SOURCE. EXPERIMENTAL EVIDENCE IN THE LITERATURE INDICATES THAT A SPECIFIC CHELATING AGENT OF THE DIKETONE TYPE, DIPIVALOYLMETHANE, HAS A SPECIFIC SELECTIVITY TOWARD LITHIUM IN THE PRESENCE OF OTHER METAL IONS IN AQUEOUS SOLUTIONS. BASED IN PART ON THIS UNIQUE PROPERTY OF DIPIVALOYLMETHANE, A CONCEPTUAL DESIGN OF A FULL SIZE PLANT IS PERFORMED TO EXTRACT LITHIUM FROM THE SMACKOVER BRINE. THE STUDY INCLUDES ALTERNATE FLOW SHEET DEVELOPMENT, DESIGN INFORMATION ON THE MAJOR UNITS OF THE PROCESS, ENERGY REQUIREMENT AND AN ECONOMIC ANALYSIS OF A 10$SUP 6$ KG LI/YR PRODUCTION FACILITY. THE ECONOMICS OF THREE DIFFERENT PROCESS CONCEPTS DEPENDS ON THE AMOUNT OF WATER EVAPORATED FROM THE INITIAL OILFIELD FEED WATERS TO CONCENTRATE THE BRINE. RESULTS

AS A FUNCTION OF PRODUCTION RATES ARE INDICATED IN A GENERAL MANNER.

DESCRIPTORS AQUEOUS SOLUTIONS;BRINES;CHELATING AGENTS;DESIGN;ELECTRIC BATTERIES;INDUSTRIAL PLANTS;LITHIUM: T1;LITHIUM-SULFUR BATTERIES;MATERIALS;OIL FIELDS;SOLVENT EXTRACTION: Q1; THERMONUCLEAR REACTOR MATERIALS

B-73

99/5/0000039-0000118// 111

ACCESSION NO. 76Y0032311
TITLE MATERIALS PROBLEMS IN RECHARGEABLE BATTERIES
AUTHORS CAIRNS, E.J.
AUTHOR AFF GENERAL MOTORS CORP., WARREN, MI
TITLE(MONO) CRITICAL MATERIALS PROBLEMS IN ENERGY PRODUCTION
EDITOR OR COMP STEIN, C. (ED.)
PAGE NO 665-710
PUBL LOC ACADEMIC PRESS, INC., NEW YORK
DATE 1976
CATEGORIES EDB-250903;360100;360200;360600
PRIMARY CAT EDB-250903
ABSTRACT TOPICS COVERED IN THIS REVIEW INCLUDE: GENERAL GUIDELINES FOR THE SELECTION OF ACTIVE MATERIALS; AMBIENT-TEMPERATURE CELLS WITH ACID ELECTROLYTES; AMBIENT-TEMPERATURE CELLS WITH ALKALINE ELECTROLYTES; HIGH TEMPERATURE CELLS WITH MOLTEN SALT ELECTROLYTES. THE LITHIUM/METAL-SULFIDE CELLS; AND HIGH TEMPERATURE CELLS WITH SOLID ELECTROLYTES. THE SODIUM/SULFUR CELLS. (GHT)
DESCRIPTORS ELECTRIC BATTERIES: T1;ELECTRODES;ELECTROLYTES;MATERIALS; REVIEWS: Q1

B-74

ACCESSION NO. 76C0032277
TITLE FEDERAL BATTERY PROGRAM FOR TRANSPORTATION USES
AUTHORS LANDGREBE, A.R. ; KLUNDER, K.; YAO, N.P.
AUTHOR AFF ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, WASHINGTON, DC
TITLE(MONO) TWENTY-SEVENTH POWER SOURCES SYMPOSIUM
PAGE NO 23-27
CONF TITLE 27. POWER SOURCES SYMPOSIUM
CONF PLACE FORT MONMOUTH, NJ, USA
CONF DATE 21 JUN 1976
PUBL LOC PSC PUBLICATION COMMITTEE, RED BANK, NJ
DATE 1976
DROP NOTE SEE CONF-760617--
CATEGORIES EDB-250902
PRIMARY CAT EDB-250902
ABSTRACT A BRIEF HISTORY OF ELECTRIC VEHICLES IS GIVEN, AND JUSTIFICATIONS FOR DEVELOPING ELECTRIC VEHICLES ARE ADDUCED. PERFORMANCE GOALS ARE TABULATED. BATTERY SYSTEMS CHOSEN FOR MAJOR DEVELOPMENT EFFORT ARE ADVANCED LEAD--ACID, NICKEL--IRON, NICKEL--ZINC, ZINC--AIR, IRON--AIR, LITHIUM--METAL SULFIDE, AND SODIUM--SULFUR. THE STATUS OF EACH OF THESE IS DISCUSSED, AND RELATIVE FIGURES OF MERIT ARE ASSIGNED. 7 TABLES. (RWR)
DESCRIPTORS COMPARATIVE EVALUATIONS: Q2,Q3,Q4,Q5,Q6,Q7,Q8;ELECTRIC BATTERIES: Q1;ELECTRIC-POWERED VEHICLES: T1;IRON-AIR BATTERIES: T6;IRON-NICKEL BATTERIES: T3;LEAD-ACID BATTERIES: T2; LITHIUM-SULFUR BATTERIES: T7;NICKEL-ZINC BATTERIES: T4; PERFORMANCE;SODIUM-SULFUR BATTERIES: T8;ZINC-AIR BATTERIES: T5

B-75

ACCESSION NO. 78Y0032235
TITLE STATIONARY BATTERY WITH LOW RESISTANCE
AUTHORS SUEMATSU, K.
AUTHOR AFF JAPAN STORAGE BATTERY CO., KYOTO
TITLE(MONO) RECHARGEABLE BATTERIES IN JAPAN
EDITOR OR COMP MIYAKE, Y.; KOZAWA, A. (EDS.)
PAGE NO 475-476
PUBL LOC JEC PRESS INC., CLEVELAND
DATE 1977
CATEGORIES EDB-250901
PRIMARY CAT EDB-250901
ABSTRACT STORAGE BATTERIES OF THE HS TYPE FUNCTION AS POWER SUPPLIES FOR ELECTRONIC COMPUTERS, SWITCH GEAR OPERATIONS, UNINTERRUPTIBLE POWER SYSTEMS, ETC. THE HS CELL HAS SEVERAL ELEMENTS WITH RELATIVELY SMALL-SIZED PLATES IN A LARGE PLASTIC CONTAINER; ALL ELEMENTS ARE IMMERSED IN A COMMON ELECTROLYTE AND ARE CONNECTED

IN PARALLEL. FEATURES OF THESE BATTERIES ARE DESCRIBED AND TABULATED. 1 FIGURE. 1 TABLE. (RWR)

DESCRIPTORS — COMPUTERS;LEAD-ACID BATTERIES: T1;POWER SUPPLIES;SIZE; SPECIFICATIONS: Q1;WEIGHT

B-76

ACCESSION NO. — 78Y0032226
TITLE — GLASS FIBER TUBULAR TYPE INDUSTRIAL BATTERIES
AUTHORS — OKAZAKI. I.; YONEZU. K.
AUTHOR AFF — JAPAN STORAGE BATTERY CO.. LTD.. KYOTO
TITLE(MONO) — RECHARGEABLE BATTERIES IN JAPAN
EDITOR OR COMP — MIYAKE. Y.; KOZAWA. A. (EDS.)
PAGE NO — 197-237
PUBL LOC — JEC PRESS INC.. CLEVELAND
DATE — 1977
CATEGORIES — EDB-250901;250902
PRIMARY CAT — EDB-250901
ABSTRACT — DETAILS OF GLASS-FIBER. TUBULAR-TYPE INDUSTRIAL BATTERIES AND THEIR ACCESSORIES ARE DESCRIBED UNDER THE FOLLOWING TOPICS: CONSTRUCTION AND MANUFACTURING PROCESS OF TUBULAR-TYPE PLATES; PERFORMANCE (DISCHARGE AND CHARGE CHARACTERISTICS. SELF-DISCHARGE. H$SUB 2$ EVOLUTION. LIFETIME); CONSTRUCTION. SPECIFICATION. AND STANDARDS FOR TUBULAR-TYPE BATTERIES; INSTRUCTIONS FOR USE OF TUBULAR-TYPE BATTERIES AND ACCESSORIES (PRECAUTIONS FOR DAILY MAINTENANCE. CHARGER AND CHARGE CHARACTERISTICS. ALARM DEVICES FOR MAINTENANCE OF BATTERIES. WATER FILLING DEVICES. CATALYST PLUG); AND RECENT PATENTS ON TUBULAR-TYPE BATTERIES. 19 FIGURES. 6 TABLES. (RWR)
DESCRIPTORS — ELECTRIC-POWERED VEHICLES: T1;ELECTRODES;FIBERS;GLASS;LEAD-ACID BATTERIES: Q1. T2;MAINTENANCE: Q2;MANUFACTURING: Q2;PERFORMANCE: Q2;SPECIFICATIONS;STANDARDS;TUBES

B-77

ACCESSION NO. — 78J0026953
TITLE — KINETICS OF THE SELF-DISCHARGE REACTION IN A SEALED LEAD--ACID CELL
AUTHORS — BULLOCK. K.R.; MCCLELLAND. D.H.
AUTHOR AFF — GATES RUBBER CO.. DENVER
PUB DESC — J. ELECTROCHEM. SOC.. V. 123. NO. 2. PP. 327-331
DATE — MAR 1976
CATEGORIES — EDB-250902
PRIMARY CAT — EDB-250902
AUGMENTATION — 35 TO 65 DEGREES C
ABSTRACT — THE KINETICS AND MECHANISM OF THE SELF-DISCHARGE REACTION IN A SEALED. LEAD—ACID CELL WERE INVESTIGATED. THE UNIQUE CELL DESIGN AND THE PURITY OF THE MATERIALS USED PRODUCE A SLOWER RATE OF SELF-DISCHARGE AND A DIFFERENT MECHANISM THAN THE TRADITIONAL LEAD—ACID BATTERY. PARTICULAR ATTENTION IS GIVEN TO THE EFFECTS OF EXPANDER COMPOSITION AND PHOSPHORIC ACID CONCENTRATION ON THE REACTION. RATES OF THE REACTION ARE DETERMINED FOR TEMPERATURES IN THE RANGE OF 35 TO 65$SUP 0$C.
DESCRIPTORS — ADDITIVES;ANODES;CHEMICAL REACTION KINETICS: Q1;LEAD-ACID BATTERIES: M1;MATERIALS;MEDIUM TEMPERATURE;PH VALUE;PHOSPHORIC ACID;SEALS

B-78

ACCESSION NO. — 76J0021255
TITLE — SEALED LEAD-ACID STORAGE BATTERY
AUTHORS — SHIOMI. E.; SASAKI. S.
AUTHOR AFF — NIPPON TELEGR AND TELEPH PUBLIC CORP. ENG BUR. TOKYO. JPN
PUB DESC — JPN. TELECOMMUN. REV.. V. 19. NO. 1. PP. 63-67
DATE — JAN 1977
CATEGORIES — EDB-250902
PRIMARY CAT — EDB-250902
ABSTRACT — COMMERCIAL TESTS ON SEALED LEAD—ACID BATTERIES. USING THE CATALYST METHOD. WERE CARRIED OUT IN JAPAN. THE CATALYST MAKES IT POSSIBLE TO RECOMBINE HYDROGEN AND OXYGEN GAS GENERATED FROM A BATTERY AND REDUCE THE GASES TO WATER. THE BATTERY CAN BE SEALED MERELY BY REPLACING EXPLOSION-PROOF VENT PLUGS WITH CATALYST PLUGS.
DESCRIPTORS — HYDROGEN;LEAD-ACID BATTERIES: T1;MAINTENANCE;OXYGEN;PERFORMANCE TESTING: Q1;RECOMBINATION;SEALS;SERVICE LIFE;VENTS

B-79

ACCESSION NO.	78C0016358
TITLE(MONO)	LITHIUM--ALUMINUM/METAL SULFIDE BATTERIES
TITLE(SERIAL)	77-483
EDITOR OR COMP	STEUNENBERG, R.K.
PAGE NO	10
CONF TITLE	AIAA CONFERENCE ON THE FUTURE OF AEROSPACE POWER SYSTEMS
CONF PLACE	ST. LOUIS, MO, USA
CONF DATE	1 MAR 1977
PUBL LOC	AMERICAN INST. OF AERONAUTICS AND ASTRONAUTICS, NEW YORK
DATE	1977
CATEGORIES	EDB-250901
PRIMARY CAT	EDB-250901
AUGMENTATION	LI--AL/LICL--KCL/FE SULFIDES
ABSTRACT	RECHARGEABLE LITHIUM--ALUMINUM/METAL SULFIDE BATTERIES ARE BEING DEVELOPED FOR ELECTRIC VEHICLE PROPULSION AND FOR STATIONARY ENERGY STORAGE APPLICATIONS SUCH AS LOAD LEVELING IN ELECTRIC UTILITY SYSTEMS. ALTHOUGH THESE TWO APPLICATIONS HAVE DIFFERENT REQUIREMENTS, BATTERIES OF THIS TYPE SHOW PROMISE OF MEETING THE PERFORMANCE, LIFETIME AND COST GOALS FOR BOTH. CELLS ARE BEING PRODUCED AND TESTED BOTH IN HOUSE AND BY INDUSTRIAL SUBCONTRACTORS. CONCEPTUAL BATTERY DESIGNS HAVE BEEN DEVELOPED, AND TWO- AND THREE-CELL BATTERIES HAVE BEEN OPERATED SUCCESSFULLY. ALTHOUGH THE DEVELOPMENT WORK HAS BEEN AIMED PRIMARILY AT THESE TWO LARGE-SCALE APPLICATIONS, BATTERIES OF THIS TYPE MAY FIND NEAR-TERM USE IN MORE SPECIALIZED APPLICATIONS THAT REQUIRE HIGH SPECIFIC ENERGY AND POWER, BUT WHERE THE COST RESTRICTIONS ARE LESS STRINGENT. 7 FIGURES, 11 TABLES.
DESCRIPTORS	ALUMINIUM BASE ALLOYS;CHEMICAL REACTIONS;DESIGN; ELECTRIC-POWERED VEHICLES: T1;ELECTROCHEMISTRY;IRON SULFIDES; LITHIUM ALLOYS;LITHIUM CHLORIDES;LITHIUM-SULFUR BATTERIES: Q1,Q2,M3;MATERIALS;OFF-PEAK ENERGY STORAGE: T2;PERFORMANCE TESTING;POTASSIUM CHLORIDES;PYRITE;REVIEWS: Q3

B-80

ACCESSION NO.	78C0003556
TITLE(MONO)	DELCO REMY FREEDOM BATTERY
EDITOR OR COMP	HELMS, J.L.; COYNER, J.M.; HILL, C.W.
SEC REPT NO	CONF-770205--80
PAGE NO	6
CONF TITLE	CONFERENCE OF THE SAE INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION
CONF PLACE	DETROIT, MICHIGAN, UNITED STATES OF AMERICA (USA)
CONF DATE	28 FEB 1977
PUBL LOC	SOCIETY OF AUTOMOTIVE ENGINEERS, INC., WARRENDALE, PA
DATE	1977
CATEGORIES	EDB-250902
PRIMARY CAT	EDB-250902
ABSTRACT	THE DELCO REMY FREEDOM BATTERY INTRODUCES AN AUTOMOTIVE BATTERY THAT IS INDEPENDENT OF OWNER CARE. NEW MATERIALS, CHEMISTRY, AND MANUFACTURING PROCESSES USED TO PRODUCE A BATTERY THAT IS HIGHLY EFFICIENT AND COMPLETELY MAINTENANCE FREE ARE DESCRIBED. CHARACTERISTICS OF THE BATTERY PERMIT INSTALLATION IN TODAY'S UNDERHOOD ENVIRONMENTS, PLUS A NEW FLEXIBILITY FOR REMOTE MOUNTING. IMPROVED STRENGTH AND LOWER WEIGHT ELIMINATE MANY BATTERY HANDLING PROBLEMS DURING ASSEMBLY. IN THE AFTERMARKET, ACID FILLING AND ASSOCIATED OSHA REQUIREMENTS ARE ELIMINATED. IMPROVED STAND CHARACTERISTICS PERMIT LONG SHELF LIFE WITHOUT DETERIORATION. CAR OWNERS ARE SET FREE FROM CONCERN WITH BATTERY MAINTENANCE, PROVIDED PLENTY OF COLD WEATHER STARTING POWER, AND ASSURED HIGH RESISTANCE TO HEAT AND VIBRATION DAMAGE. 11 FIGURES.
DESCRIPTORS	AUTOMOBILES: T1;BATTERY CHARGING;CHEMICAL REACTIONS;CONTAINERS; DESIGN;GRIDS;LEAD-ACID BATTERIES: Q1,T2;MANUFACTURING;MATERIALS; PERFORMANCE: Q2

B.81 Chloride Silent Power Ltd., Runcorn, England, Private Communication.

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B.89 Brusaglina, G. "Fiat Electric Vehicles Development Process", EVC Expo 80 Conference Proceedings, St. Louis, Missouri, 1980.

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B.95 Rosey, R., "Westinghouse Nickel Iron Battery Design and Performance", EVC Expo 80 Proceedings, St. Louis, Missouri, 1980.

B.96 Hudson, R., "Development of the Nickel-Iron Battery System for Electric Vehicle Propulsion", EVC Expo 80 Conference Proceedings. St. Louis, Missouri, 1980.

B.97 Pearlman, E., "Nickel/Zinc VIBROCEL^{TM} Battery Design and Performance", EVC Expo 80 Conference Proceedings, St. Louis, Missouri, 1980.

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B.101 Hamilton, W.F., "The Potential of Range-Extension Hybrid Electric Cars", EVC Expo 80 Conference Proceedings, St. Louis, Missouri, 1980.

B.102 Dmitrenko, V.E., "Means of Improving Nickel-Zinc Storage Batteries for Electric Vehicle Power Plant", EVC Expo 80 Conference Proceedings, St. Louis, Missouri, 1980.

B.103 Surin, E.I., "Prospects of EV Development and Use in the U.S.S.R.", EVC Expo 80 Conference Proceedings, St. Louis, Missouri, 1980.

B.104 Escher, W., Foster, R., "An Assessment of the Status of Fuel Cell/ Battery Vehicle Power Systems", a paper prepared by Escher: Foster Technology Associates, Inc. for the U.S. Department of Energy, St. Johns, Michigan, February 1980.

B.105 "Electric and Hybrid Vehicle Program", a quarterly report prepared by the U.S. Department of Energy, Washington, D.C., August, 1980.

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B.112 "Commercialization Strategy for Lead/Acid Batteries in Utility Load Leveling Applications", a report prepared by Arthur D. Little, Inc., Massachusetts, for the U.S. Department of Energy, Washington, D.C., June 1980.

B.113 Momyer, W.R., Morris, J.L., "Reactive Metal-Air Batteries for Automotive Propulsion", a final report prepared by Lockheed Missiles and Space Company, Inc., Palo Alto, California for the U.S. Department of Energy, Washington, D.C., December, 1979.

B.114 Donnelly, J.J., Greayer, W.C., et al., "Study of Hydrogen-Powered Versus Battery-Powered Automobiles", prepared by The Aerospace Corporation, El Segundo, California, for the U.S. Department of Energy, Washington, D.C., May 1979.

THERMAL ENERGY STORAGE SYSTEMS

Analysis

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Information was gathered for systems utilizing six storage media: olivine ceramic brick, magnesite ceramic brick, calcium chloride hexahydrate, sodium sulfate decahydrate, sodium thiosulfate pentahydrate, and form-stable polyethylene.

Olivine Ceramic Brick

This medium is used commercially in conjunction with electric resistance heating to provide thermal energy at peak times using previously purchased off-peak power. Sufficient information was obtained for determining efficiency, lifetime, installed cost, operating and maintenance cost, volume, floor space, weight, and charge/discharge times.

The following parameters have been related to system size and mathematical functions obtained.

Olivine Brick Installed Cost (OBIC)

$$OBIC = 8.88 - 0.81 (\log x) \qquad (34)$$

where OBIC is in dollars per thousand Btu capacity, or size, and x = size in Btu.

Standard Error = 0.79

Olivine Brick Annual O&M Cost (OBMC)

$$OBMC = 9.02 - 1.26 \log x \qquad (35)$$

where OBMC is a percentage of installed cost

Standard Error = 0.019

Volume of Olivine Brick System (VOBS)

$$VOBS = 0.16 \qquad (36)$$

where VOBS is in cubic feet per thousand Btu.

Standard Deviation = 0.045

Floor Space for Olivine Brick System (FSOBS)

$$FSOBS = 0.048 \qquad (37)$$

where FSOBS is in square feet per thousand Btu.

Standard Deviation = 0.039

Weight of Olivine Brick System (WOBS)

$$WOBS = 4.52 \qquad (38)$$

where WOBS is in pounds per thousand Btu

Standard Deviation = 0.93

Predicted values based on these mathematical functions are presented in Table 67. Plots of Equations 34 through 38 are shown in Figures 33 through 37.

Data obtained on efficiency, lifetime, and charge/discharge times does not exhibit a relation to size.

Efficiency

Because ceramic brick resistance storage heaters are installed within the volume to be heated, heat losses from the bricks still provide desirable heating. Thus efficiency approaches 100%. This is also generally true for systems using other storage medium. Fan and control losses are minor. Total system efficiency is presumed to be about 95%.

Another measure of energy stored compared to energy required or desired is charge acceptance. If a large proportion of thermal energy stored is retained until needed, than the charge acceptance of the system is high. While no data was found on charge acceptance, values should be high because during the diurnal operation considered here, heat removal from storage follows soon after charging and little unwanted heat has time to dissipate.

Lifetime

Expected lifetime is reported to be 20 years.

Charge/Discharge Time

Charge time for commercial units is about 16 hours. Discharge times are reported to range from 5 to 10 hours, with a median value of 8 hours.

Mobility

Systems sized larger than about 380,000 Btu are fixed. Smaller systems are mobile.

Availability of Raw Materials

Availability of the olivine mineral is somewhat limited in the U.S. Known reserves exist in North Carolina and Washington. U.S. manufacturers import their ceramic bricks.

Table 67. VALUES OF THE OLIVINE BRICK PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

System Capacity or Size, Btu	(Equation 34) Installed Cost of the Olivine Brick System, $/k Btu (± 0.79)	(Equation 35) Annual O&M Cost, % of Installed Cost (± 0.019)	(Equation 36) Volume of the Olivine Brick System, ft^3/k Btu (± 0.045)	(Equation 37) Floor Space of the Olivine Brick System, ft^2/k Btu (± 0.039)	(Equation 38) Weight of the Olivine Brick System lbs/k Btu (± 0.93)
50,000	5.09	3.09	0.16	0.048	4.51
100,000	4.85	2.71	0.16	0.048	4.51
250,000	4.53	2.20	0.16	0.048	4.51
500,000	4.28	1.82	0.16	0.048	4.51
1,000,000	4.04	1.44	0.16	0.048	4.51
5,000,000	3.48	0.56	0.16	0.048	4.51

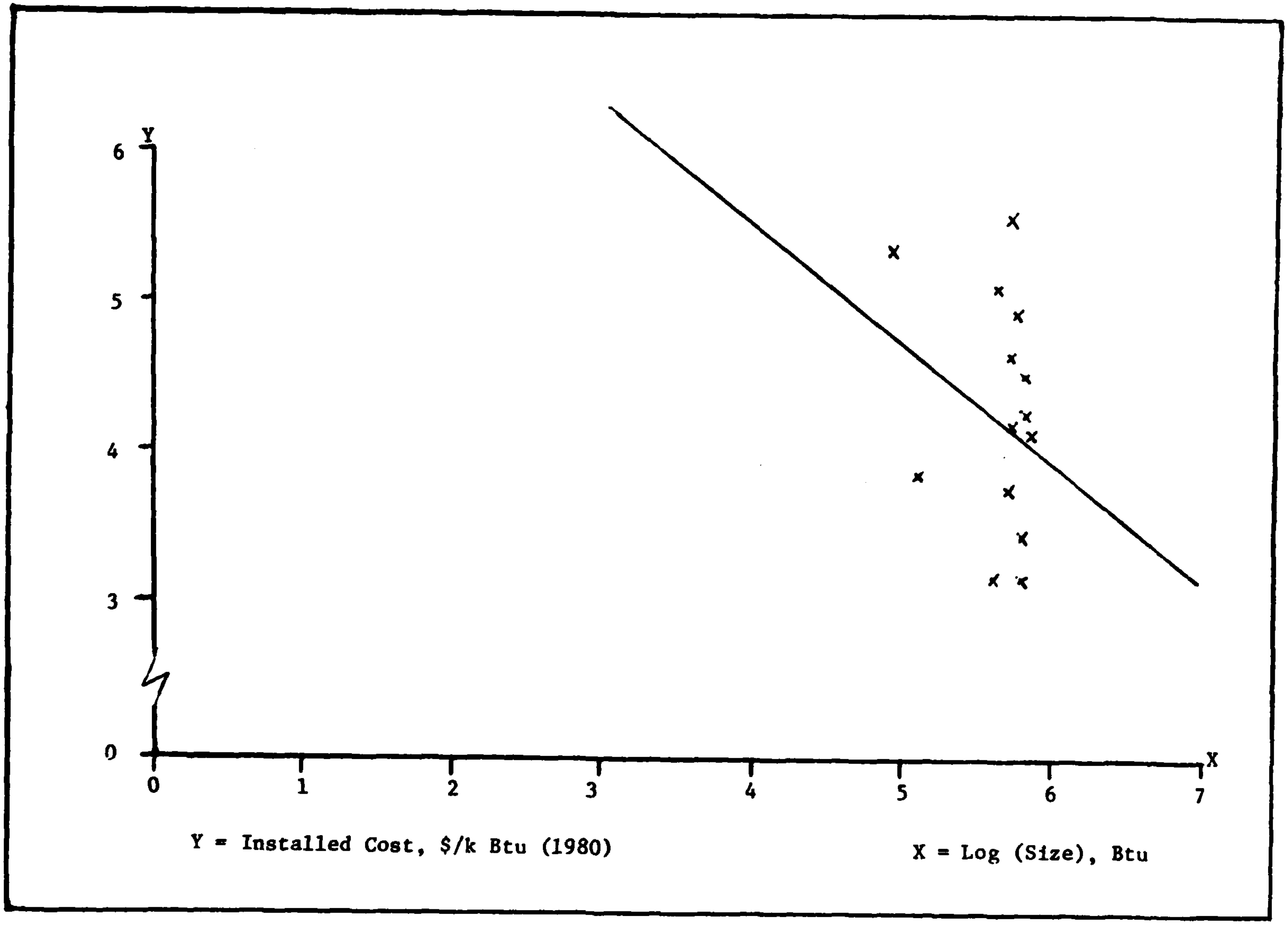

Figure 33. INSTALLED COST OF OLIVINE BRICK TES SYSTEMS

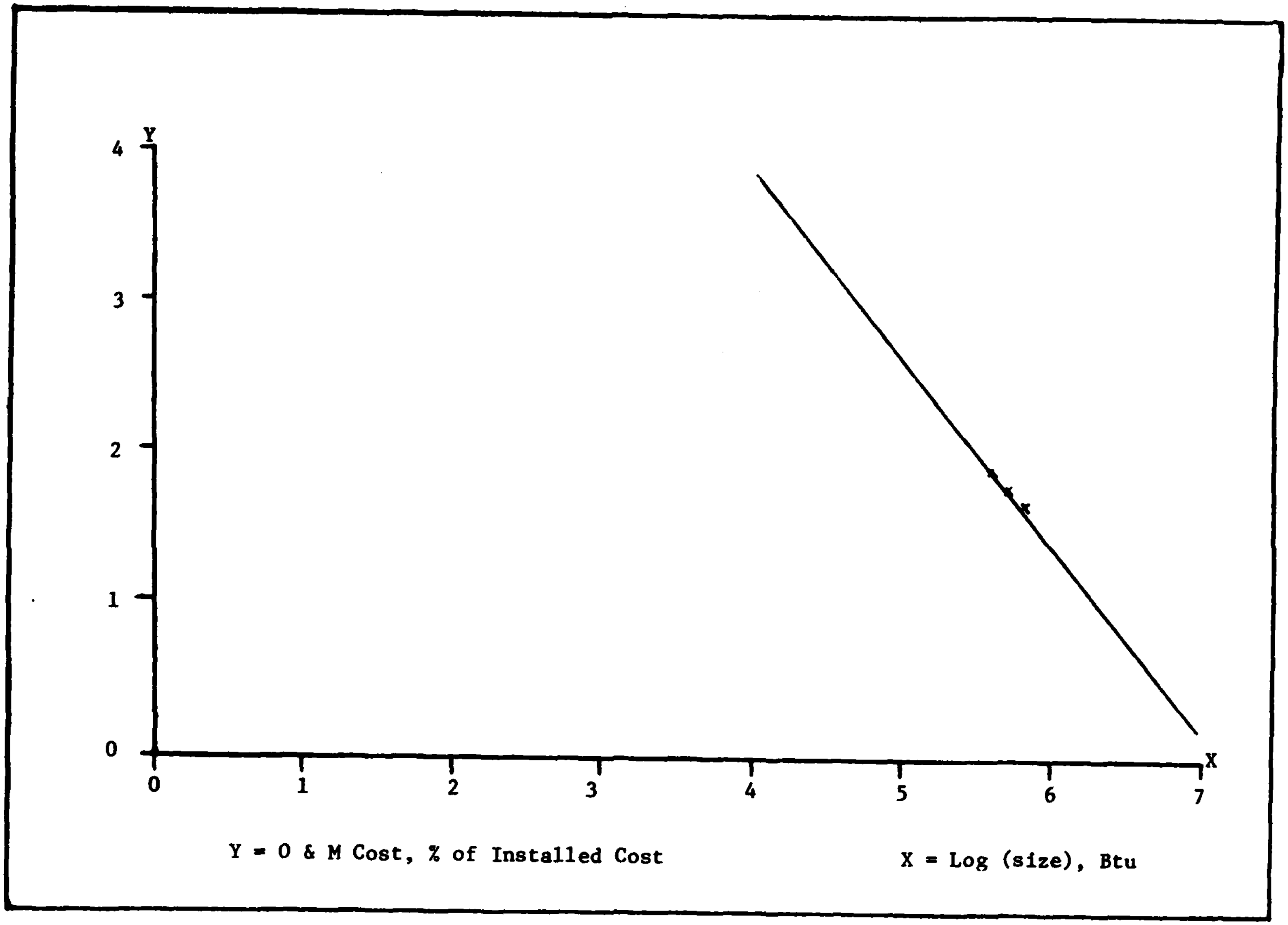

Figure 34. ANNUAL O&M COST OF OLIVINE BRICK TES SYSTEMS

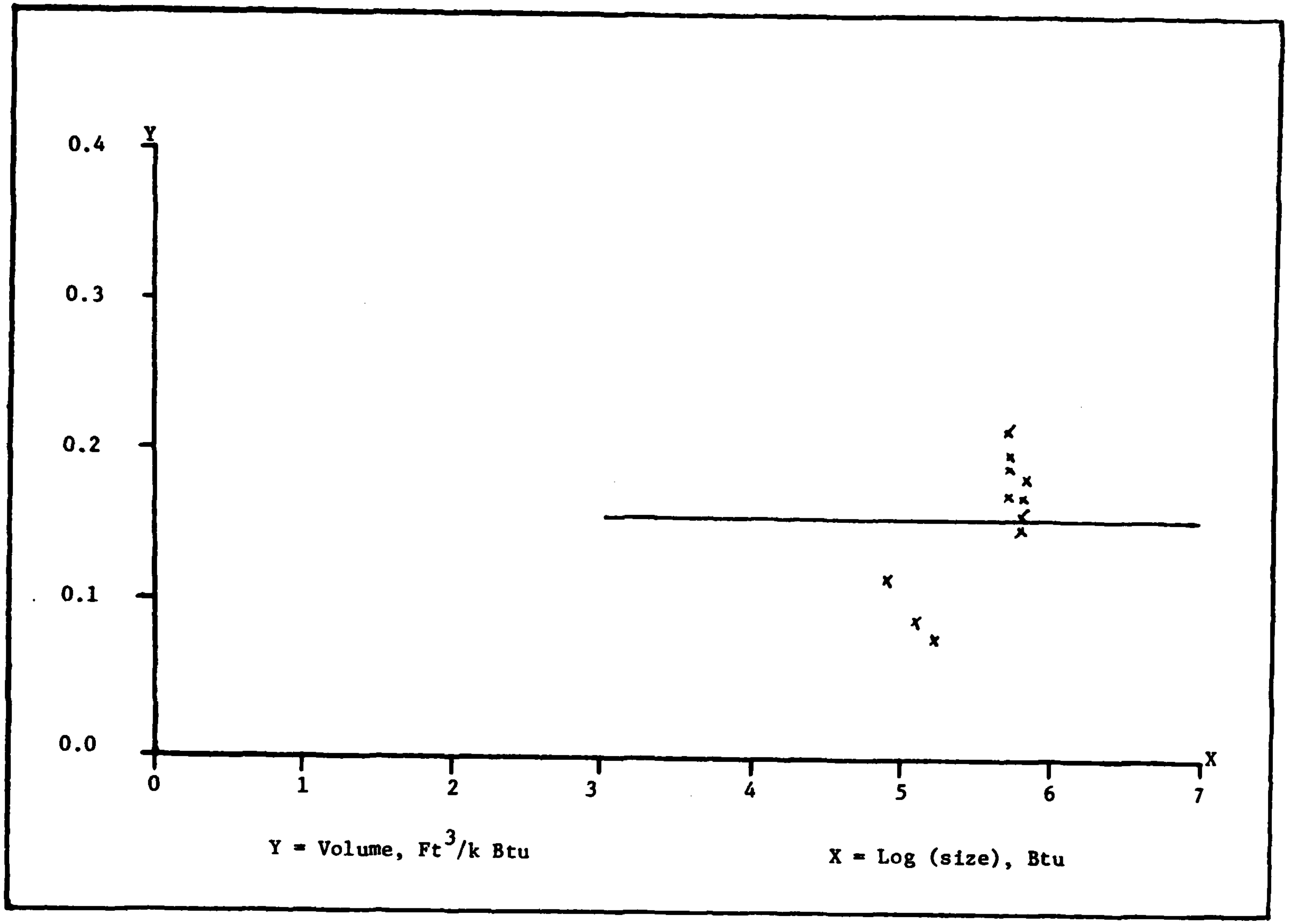

Figure 35. VOLUME OF OLIVINE BRICK TES SYSTEMS

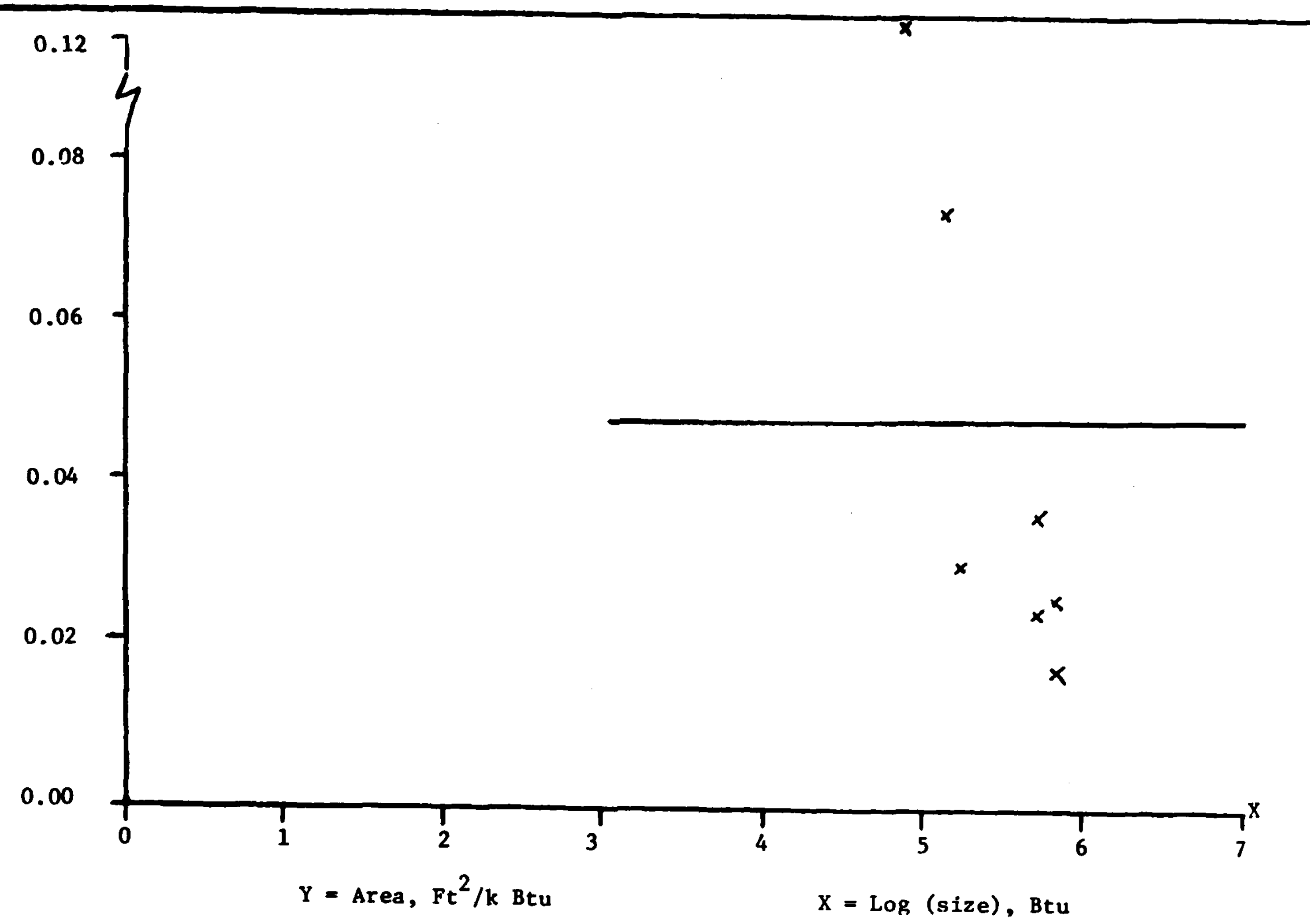

Figure 36. FLOOR SPACE OF OLIVINE BRICK TES SYSTEMS

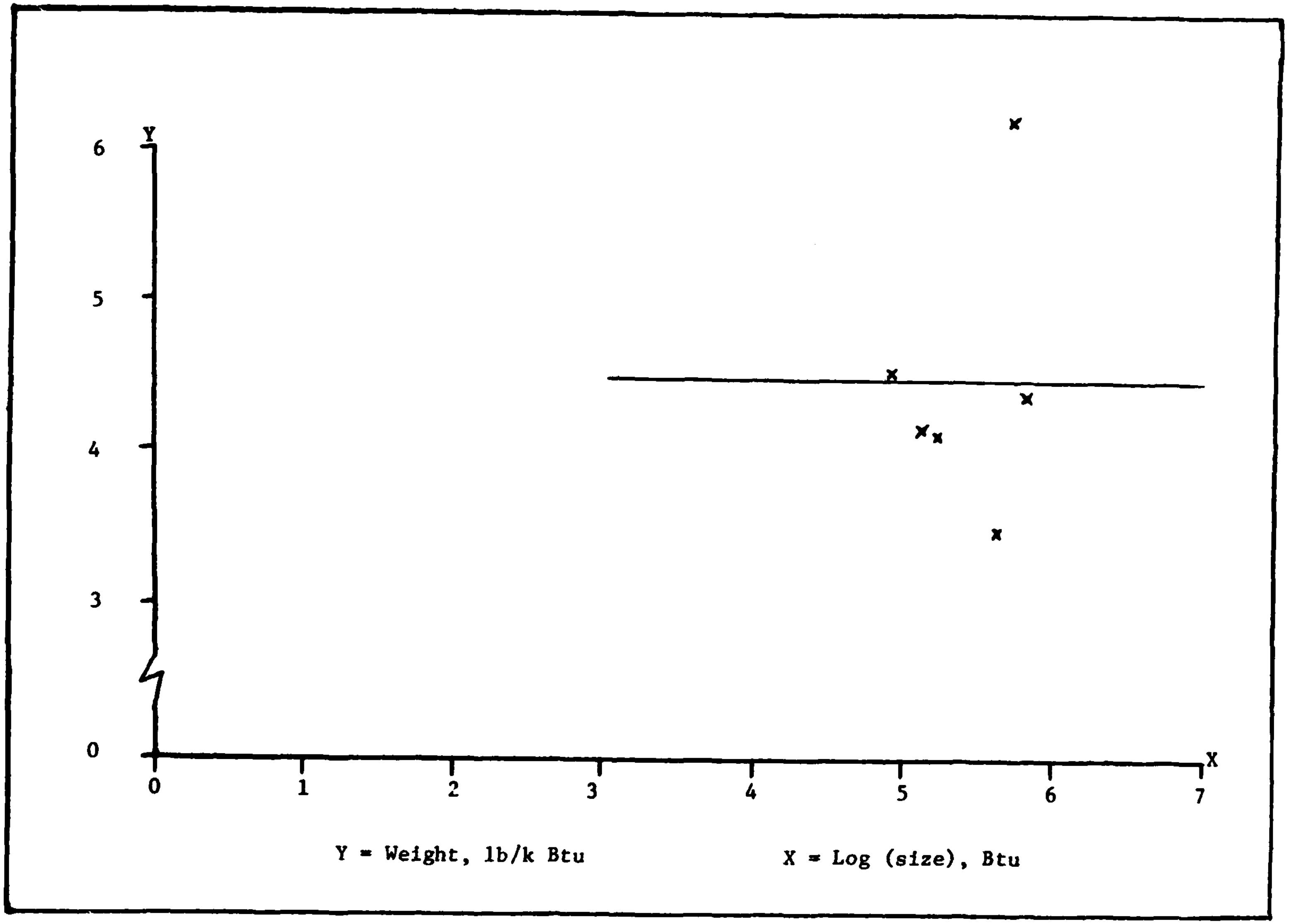

Figure 37. WEIGHT OF OLIVINE BRICK TES SYSTEMS

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 68, 69, 70, and 71, respectively.

Magnesite Ceramic Brick

This medium in used commercially in Europe in conjunction with electric resistance heating. It has also been studied for high-temperature process heat storage. Adequate information was obtained to relate installed costs, volume, and weight to system size.

Magnesite Brick Installed Cost (MBIC)

$$MBIC = 38.18 - 41.86 \log (\log x) \qquad (39)$$

where MBIC is in dollars per thousand Btu and x= size in Btu

Standard Error = 1.49

Volume of Magnesite Brick System (VMBS)

$$VMBS = 0.14 - 0.01 \log (x) \qquad (40)$$

where VMBS is in cu. ft. per thousand Btu

Standard Error = 0.04

Weight of Magnesite Brick System (WMBS)

$$WMBS = 6.41 - 0.17 \log x \qquad (41)$$

where WMBS is in pounds per thousand Btu

Standard Error = 2.55

Values predicted by the above equations are shown in Table 72, as a function of size. Plots of the equations are shown in Figures 38, 39, and 40.

Data on efficiency and charge/discharge time did not correlate with size in a defined manner. Only limited information on lifetime and O&M costs was obtained; consequently judgement was used to estimate these parameters, assuming the magnesite systems are similar to olivine ones.

Efficiency

Magnesite brick systems are reported to have very small standby losses. Efficiency should be equivalent to the 95% value assumed for olivine brick systems.

Table 68. OLIVINE BRICK TES SYSTEM LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirements	--	
2. Manning Requirements	--	
3. Fuel Availability and Delivery	●	208 volt (minimum) AC electric service required. Need off-peak or time-of-day rates for economic gains.
4. Fuel Storage	--	
5. Other	--	

Overall Assessment: The ordinal score is 4 indicating moderate locational constraints.

Table 69. OLIVINE BRICK TES SYSTEM OPERATION CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability	--	
2. Overload Cabability	●	Overloading is not possible.
3. Load Following	0	Able to follow minor load changes.

Overall Assessment: The ordinal score is 3 indicating average turn-down capability.

Table 70. OLIVINE BRICK TES SYSTEM RELIABILITY

Constraint	Effect	Remarks
1. Moving Parts	0	Fan and damper are required.
2. Operating Temperature	0	Reaches temperatures of 1200°F by design. Maximum surface temperature is 1400°F.
3. Modularity of Design	0	System can be designed around several modules with one set of controls.
4. Stress Levels	●	Floor must be able to withstand loads of 375 lbs_f per sq. ft.
5. Corrosion	--	
6. Other	--	

Overall Assessment: The ordinal score is 4 indicating moderate reliability.

Table 71. OLIVINE BRICK TES SYSTEM ENVIRONMENTAL EFFECTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	—	—	—	
• Air Pollution				
CO	—	—	—	Ceramic brick is not
NO_x	—	—	—	subject to outgassing
SO_x	—	—	—	or dusting.
HC	—	—	—	
Particulates	—	—	—	
Others	—	—	—	
• Noise	0	0	0	Fan Noise
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

Table 72. VALUES OF THE MAGNESITE BRICK PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

System Capacity, or Size, Btu	(Equation 39) Installed Cost of the Magnesite Brick System, \$/kBtu (± 1.49)	(Equation 40) Volume of the Magnesite Brick System, ft^3/kBtu (± 0.04)	(Equation 41) Weight of the Magnesite Brick System, lbs/kBtu (± 2.53)
50,000	10.04	0.10	5.63
100,000	8.92	0.10	5.58
250,000	7.52	0.09	5.52
500,000	6.54	0.09	5.47
1,000,000	5.60	0.09	5.42
5,000,000	3.60	0.08	5.30

Lifetime

While no values were found in the literature, a reasonable estimate is 20 years.

Annual O&M Cost

Assuming a similar percentage factor as for annual costs for olivine brick systems is reasonable, magnesite brick O&M costs can be represented by the equation:

$$MBMC = 9.02 - 1.26 \log x \tag{42}$$

where MBMC is a percentage of installed cost

Standard Error = 0.019

Charge/Discharge Time

Charge times ranged from 8 to 10 h with 8 hours as the median. Discharge times ranged from 6 to 16 h with 14 hours as the median.

Mobility

Magnesite systems larger than about 310,000 Btu are fixed. Smaller systems are mobile.

Availability of Raw Materials

Magnesite is abundant and widely distributed. Large deposits exist in Austria, Manchuria, and the U.S. (Clark County, Nevada).

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 73, 74, 75, and 76, respectively.

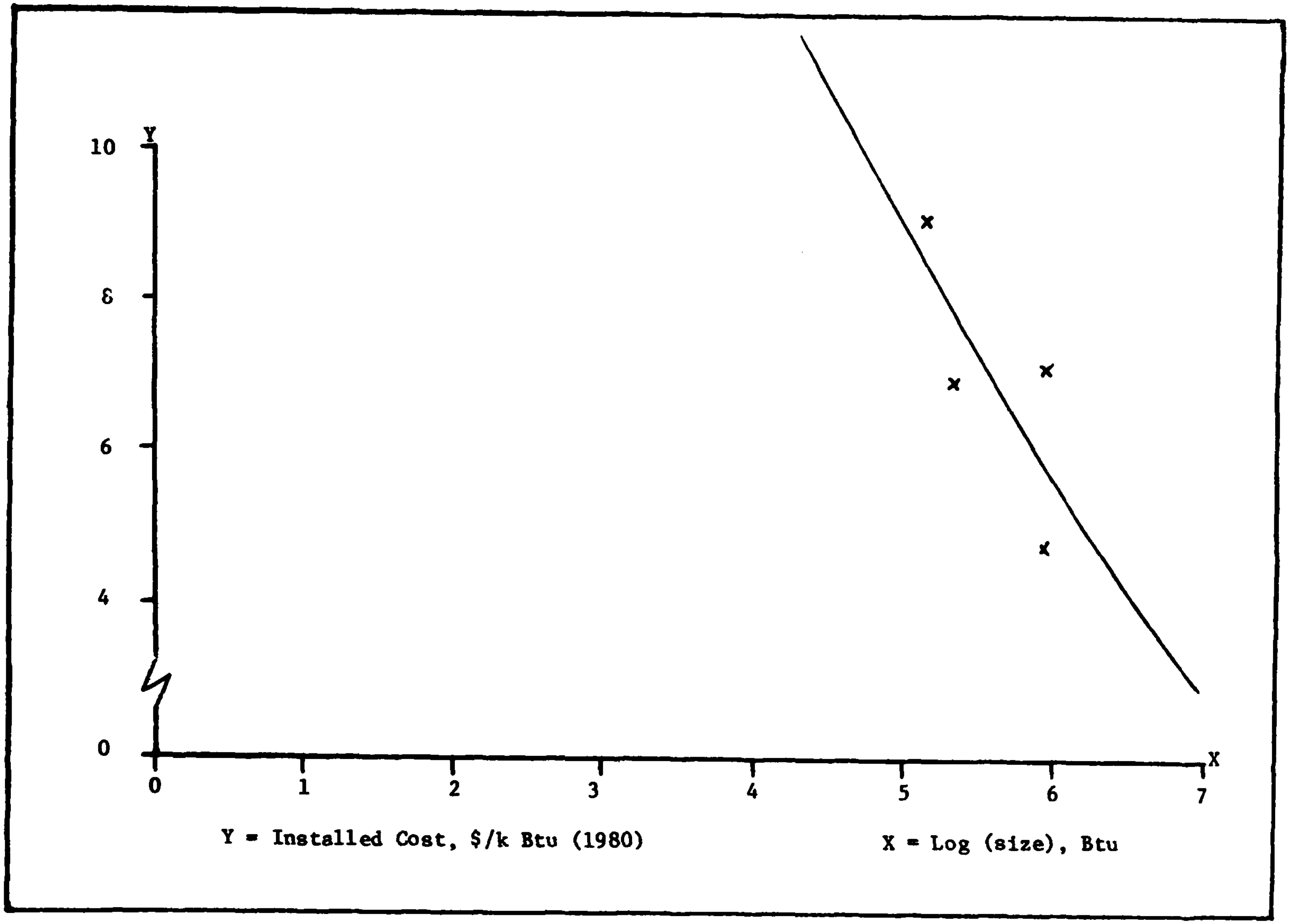

Figure 38. INSTALLED COST OF MAGNESITE BRICK TES SYSTEMS

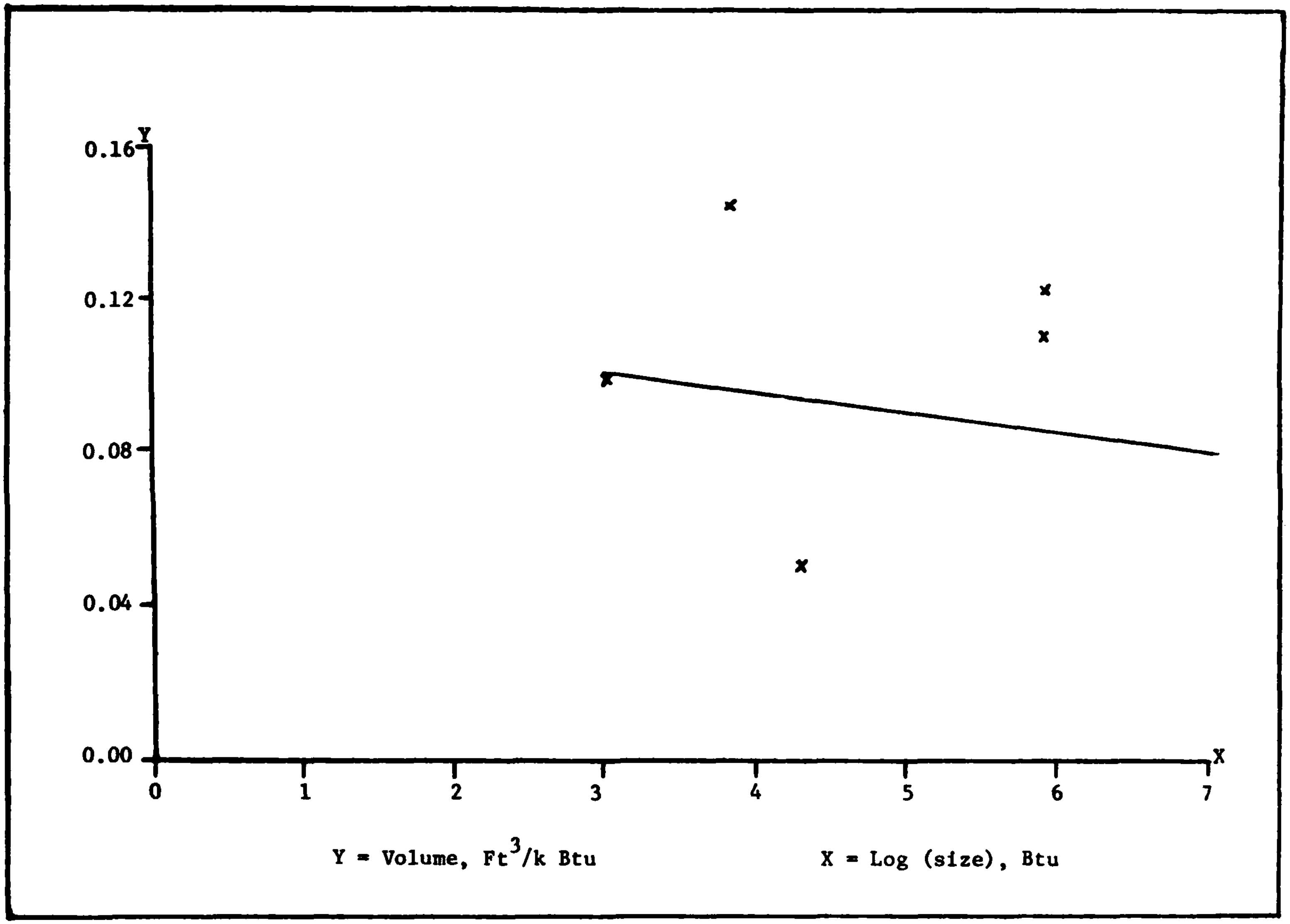

Figure 39. VOLUME OF MAGNESITE BRICK TES SYSTEMS

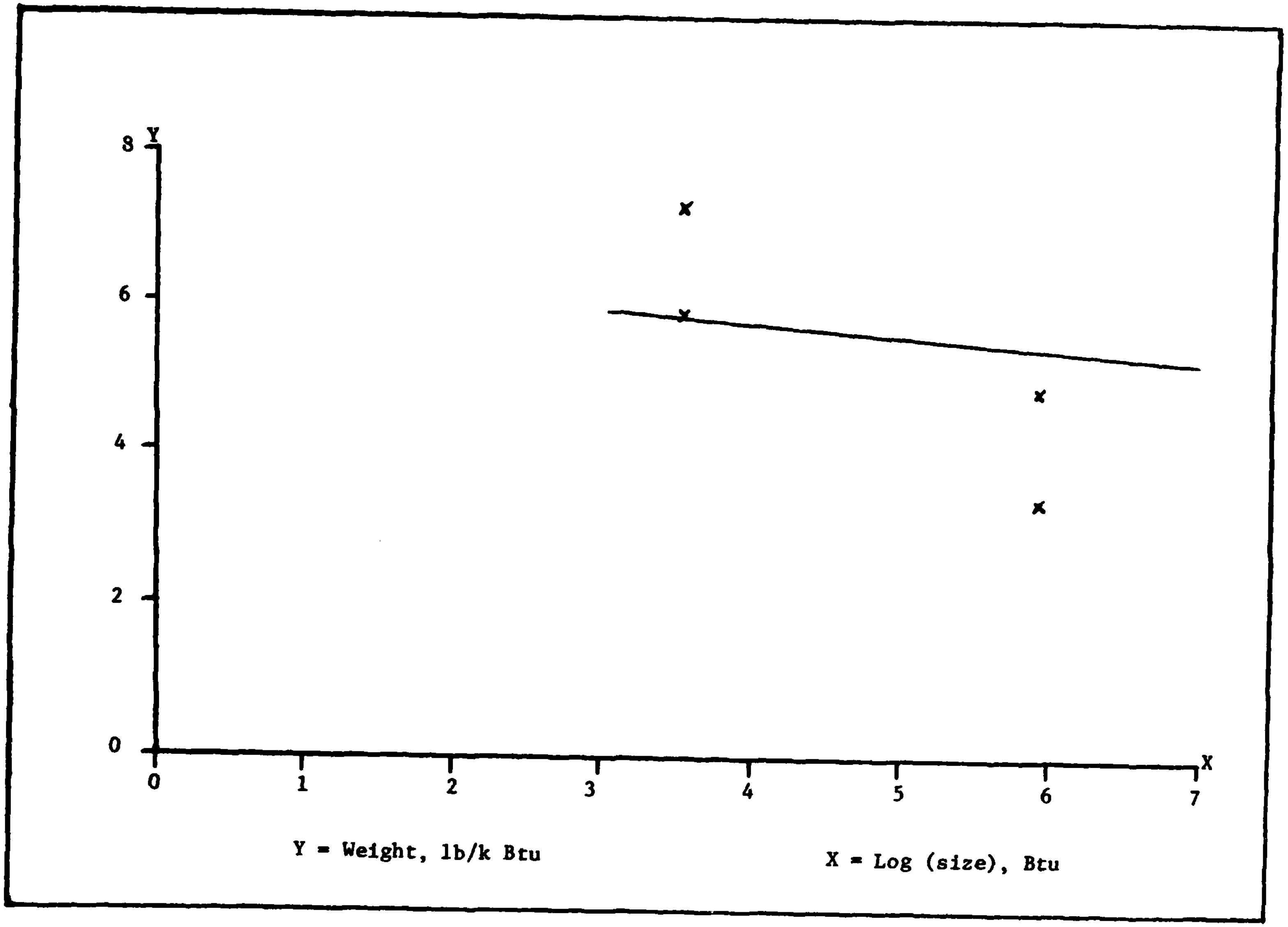

Figure 40. WEIGHT OF MAGNESITE BRICK TES SYSTEMS

Table 73. MAGNESITE BRICK TES SYSTEM LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirement	--	
2. Manning Requirements	--	
3. Fuel Availability and Delivery	●	Need off-peak or time-of-day rates for economic gains.
4. Fuel Storage	--	
5. Other	--	

Overall Assessment: The ordinal score is 4 indicating moderate locational constraints.

Table 74. MAGNESITE BRICK TES SYSTEM OPERATION CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability	--	
2. Overload Capability	●	Overloading is not possible.
3. Load Following Capability	O	Able to follow minor load changes.

Overall Assessment: The ordinal score is 3 indicating average turn-down capacity.

Table 75. MAGNESITE BRICK TES SYSTEM RELIABILITY

Constraint	Effect	Remarks
1. Moving Parts	O	Fan and damper are required
2. Operating Temperature	O	Designed for rather high temperatures
3. Modularity of the Design	O	
4. Stress Levels	●	Floor must withstand rather high floor loads. Basement placing obviates loading considerations.
5. Corrosion	--	
6. Other	--	High thermal conductivity lessens shock.

Overall Assessment: The ordinal score is 4 indicating moderate reliability.

Table 76. MAGNESITE BRICK TES SYSTEM ENVIRONMENTAL EFFECTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	—	—	—	
• Air Pollution				
CO	—	—	—	
NO_x	—	—	—	
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Others	—	—	—	
• Noise	0	0	0	Fan noise possible
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 5 indicating minimum environmental constraint.

Calcium Chloride Hexahydrate

This medium is being introduced commercially to store thermal energy. Dow USA is the principal manufacturer of this medium and associated nucleating agents. Installed cost, O&M cost, volume, and weight of these systems was found to vary as a function of size. These relationships are shown by the following equations:

Calcium Chloride Installed Cost (CCIC)

$$CCIC = 44.72 - 51.58 \log (\log x) \qquad (43)$$

where x = size in Btu, and CCIC is in dollars per thousand Btu.

Standard Error = 2.36

Annual Calcium Chloride O&M Cost (CCMC)

$$CCMC = 9.57 - 0.92 \log x \qquad (44)$$

where CCMC is in cents per thousand Btu capacity, or size.

Standard Error is not determinable (two points).

Volume of Calcium Chloride System (VCCS)

$$VCCS = 0.26 - 4.23 \times 10^{-3} \log x \qquad (45)$$

where VCCS is in cu. ft. per thousand Btu.

Standard Error = 0.10

Weight of Calcium Chloride System (WCCS)

$$WCCS = 59.28 - 62.42 \log (\log x) \qquad (46)$$

where WCCS is in pounds per thousand Btu.

Standard Error = 3.51

Values predicted by the above equations are shown in Table 77, as a function of size. The equations are plotted in Figures 41 through 44.

Data on efficiency, lifetime, and charge/discharge time did not show a relationship to size.

Efficiency

Charging and discharging efficiencies reported in the literature ranged from 82 to 99%. The lower efficiency was reported for an experimental system; a 95% efficiency is probably representative for the total cycle efficiency.

Table 77. VALUES OF THE CALCIUM CHLORIDE PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

System Capacity or Size, Btu	(Equation 43) Installed Cost of the Calcium Chloride System, \$/k Btu (± 2.36)	(Equation 44) Annual O&M Cost of Calcium Chloride System, ¢/k Btu (± undetermined)	(Equation 45) Volume of the Calcium Chloride System, ft^3/k Btu (± 0.10)	(Equation 46) Weight of the Calcium Chloride System, lbs/k Btu (± 3.51)
50,000	10.06	5.26	0.24	17.33
100,000	8.67	4.98	0.24	15.65
250,000	6.95	4.62	0.24	13.57
500,000	5.74	4.34	0.23	12.10
1,000,000	4.59	4.06	0.23	10.71
5,000,000	2.12*	3.42	0.23	7.72

* This extrapolated value should be used with caution because it is less than the standard error of the estimate.

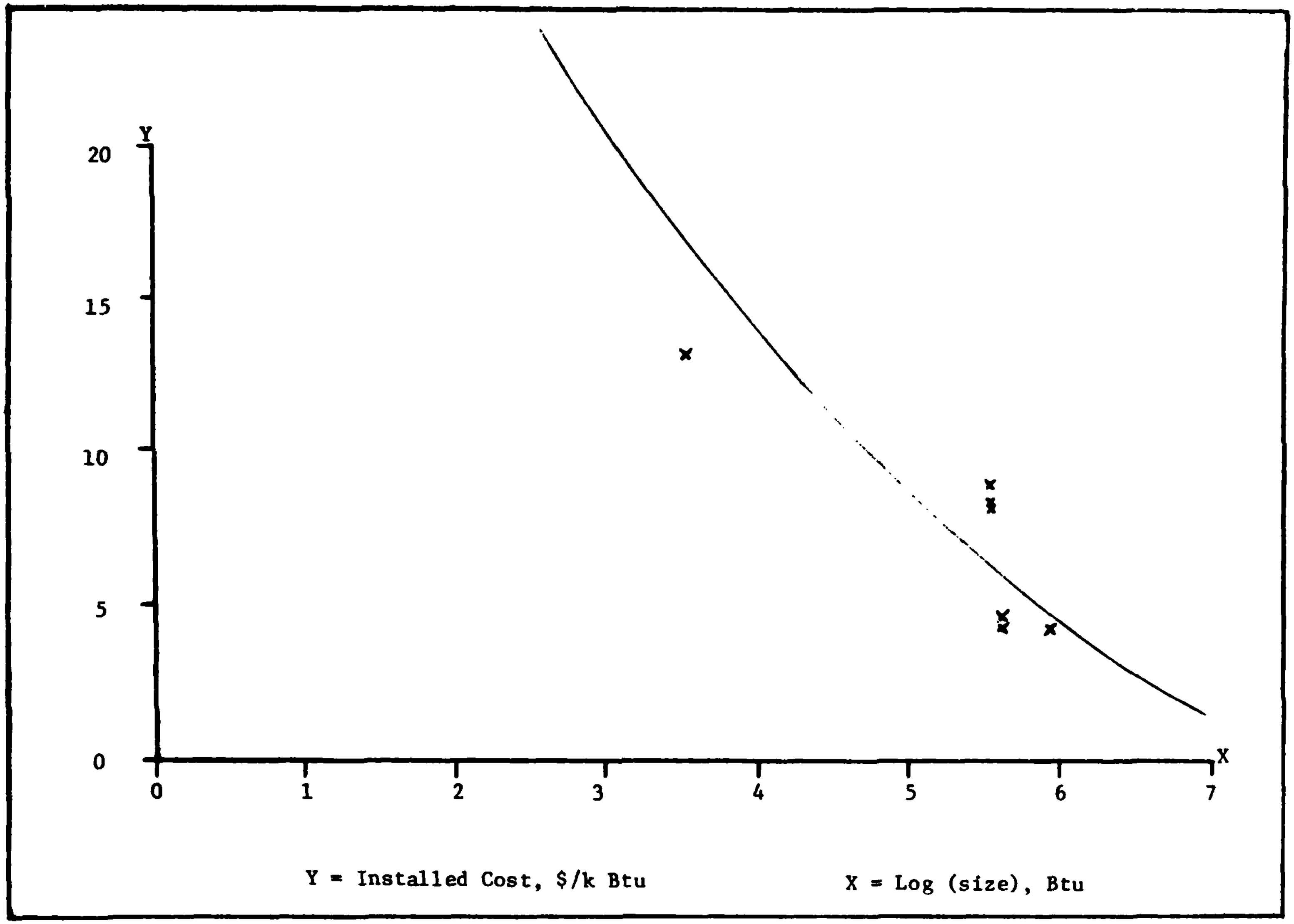

Figure 41. INSTALLED COSTS OF CALCIUM CHLORIDE TES SYSTEMS

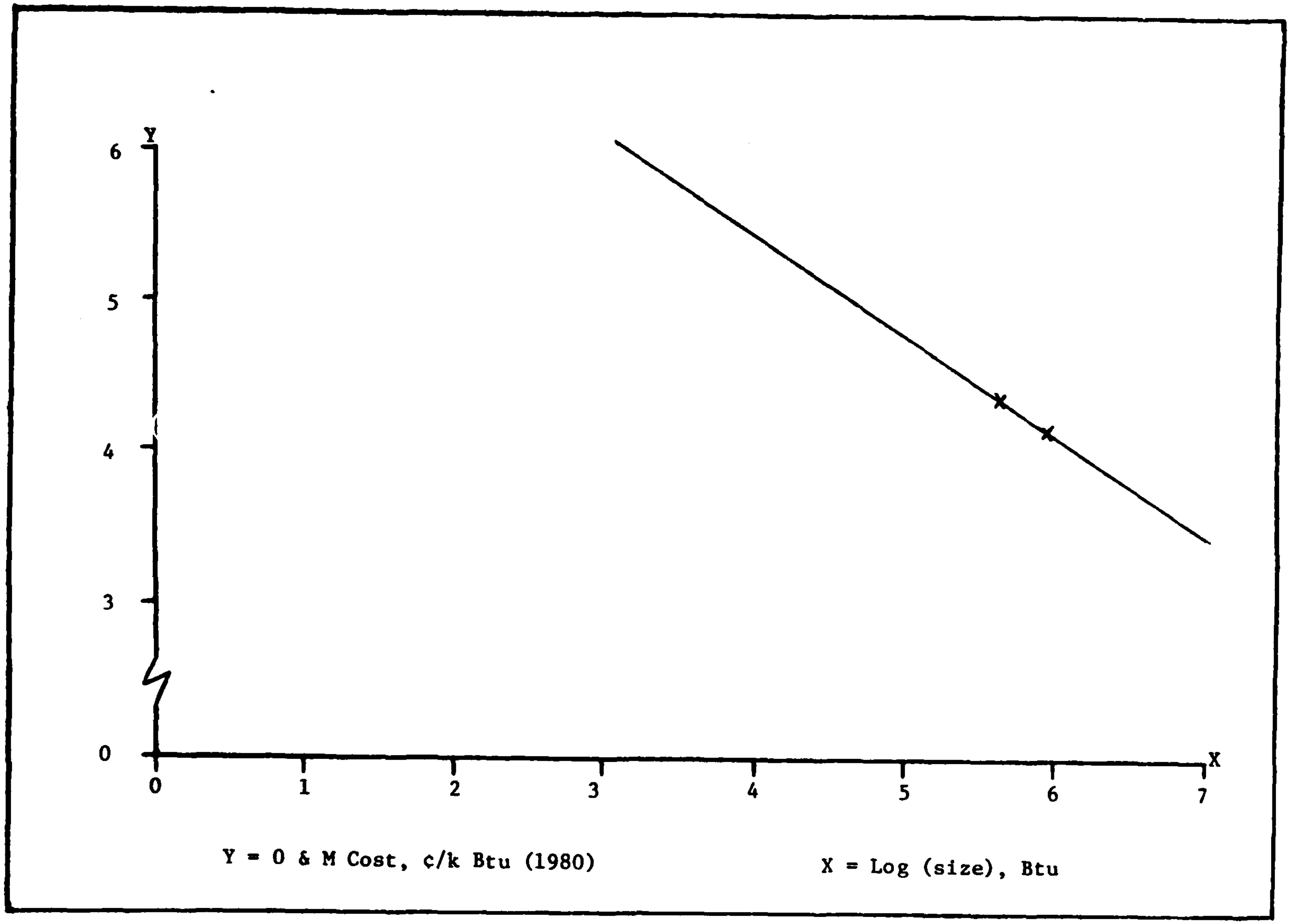

Figure 42. ANNUAL O&M COST FOR CALCIUM CHLORIDE TES SYSTEMS

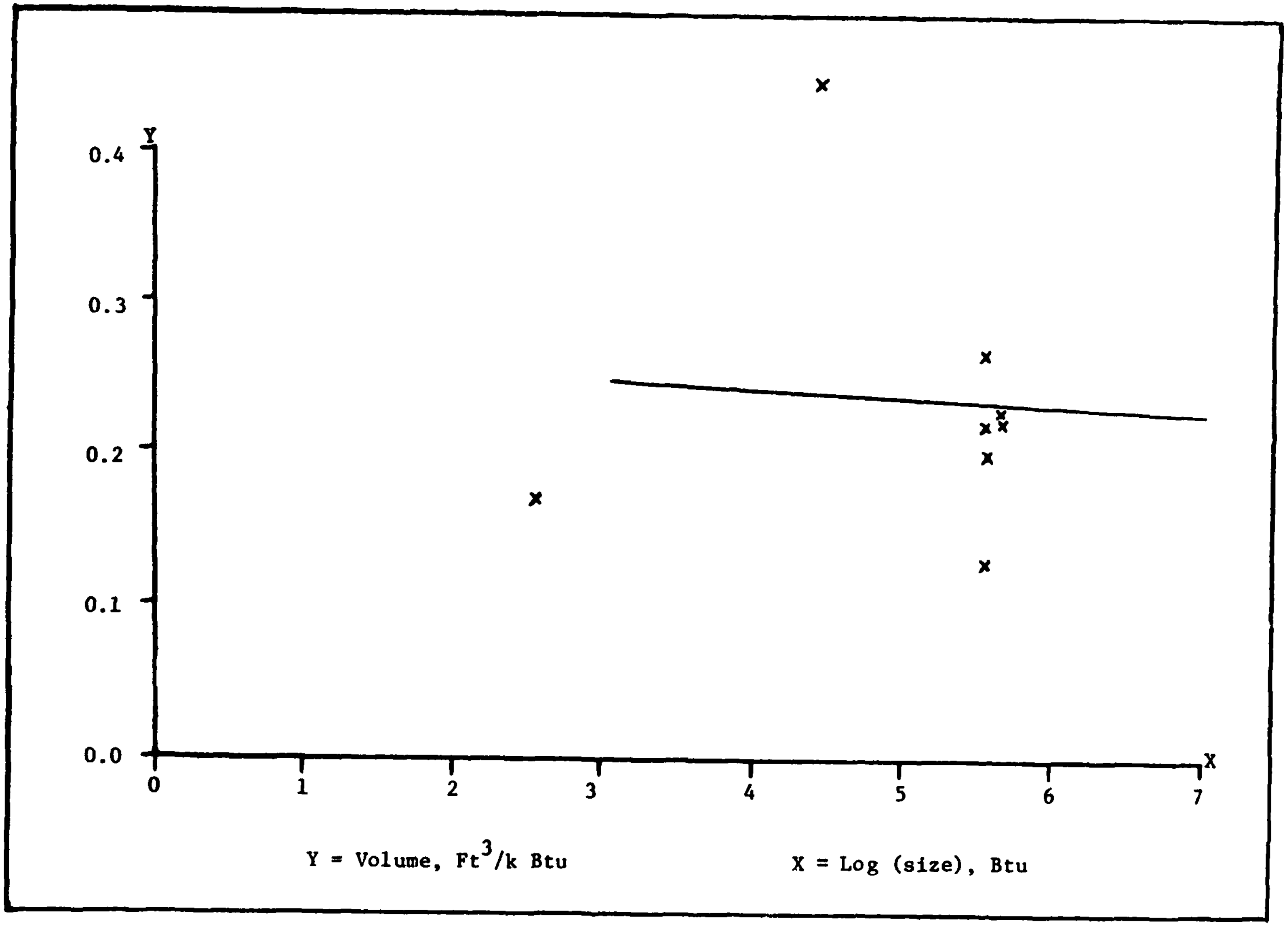

Figure 43. VOLUME OF CALCIUM CHLORIDE TES SYSTEMS

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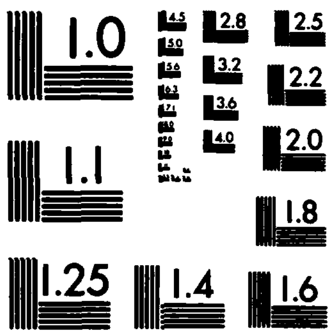

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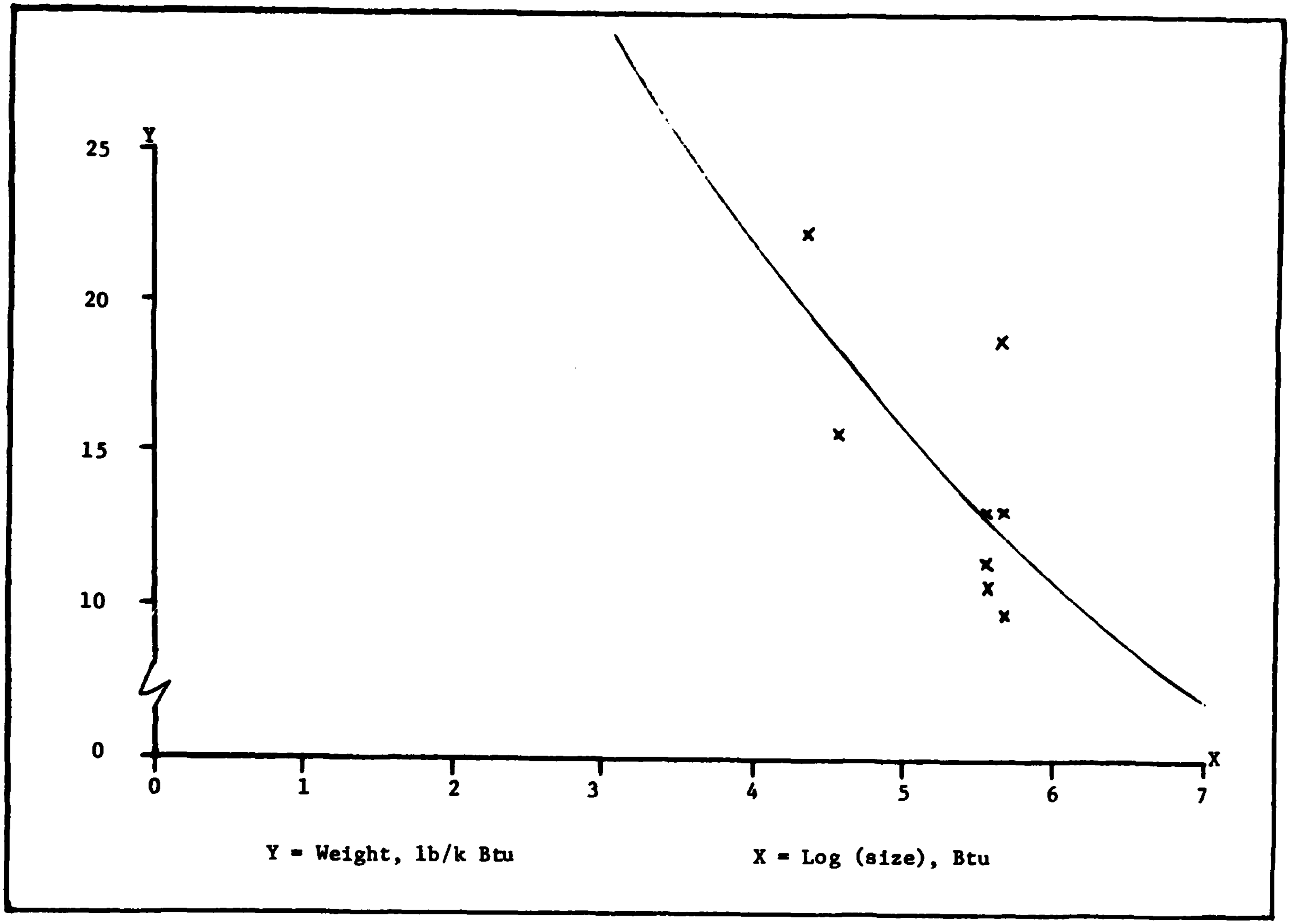

Figure 44. WEIGHT OF CALCIUM CHLORIDE TES SYSTEMS

Lifetime

Estimated lifetimes for these systems ranged from 5 to 50 yr, with 22.5 years as the median. Warranties are offered for 5 to 10 yr. An experimental system has been demonstrated for 1000 cycles, which should be considered a minimal accomplishment.

Charge/Discharge Time

Charge times range from 5 to 16 hr, with 8.5 hours as the median. Discharge times range from 12 to 36 hr, with 15.5 hours as the median.

Mobility

These systems are mobile.

Availability of Raw Materials

Calcium chloride is a common salt and widely available at about 8¢ per pound.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 78, 79, 80, and 81, respectively.

Table 78. CALCIUM CHLORIDE TES SYSTEM LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirement	--	Addition or removal of water from the hydrate decreases system life.
2. Manning Requirements	--	
3. Fuel Availability and Delivery	0	Electricity may be required for fan or charging.
4. Fuel Storage	--	
5. Other	0	Some systems rely on passive solar gain.

Overall Assessment: The ordinal score is 4 indicating moderate locational constraints.

Table 79. CALCIUM CHLORIDE TES SYTSTEM OPERATION CONSTRAINTS

Constraint	Effect	Remarks
1. Part-Load Capability	--	
2. Overload Capability	◐	Temperatures typically cannot exceed 150°F.
3. Load Following Capability	◐	Able to follow minor load changes

Overall Assessment: The ordinal score is 3 indicating average turn-down capacity.

Table 80. CALCIUM CHLORIDE TES SYSTEM RELIABILITY

Constraint	Effect	Remarks
1. Moving Parts	0	
2. Operating Temperature	0	Not to exceed about 150°F. Can sag in horizontal position
3. Modularity of the Design	--	
4. Stress Levels	0	Floors must withstand loads of about 250 lbs. per sq. ft.
5. Corrosion	◐	Corrosive salt; compatible with polyethylene, various plastic films, and drawn and seamed steel.
6. Other	--	

Overall Assessment: The ordinal score is 4 indicating moderate reliability.

Sodium Sulfate Decahydrate (Glauber's Salt)

Thermal energy storage systems using this salt are commercially available. Mathematical relationships to size were found for installed cost, O&M cost, volume, and weight.

Sodium Sulfate Installed Cost (SSIC)

$$SSIC = 64.15 - 72.37 \log(\log x) \qquad (47)$$

where SSIC is in dollars per thousand Btu capacity, or size, and x = size in Btu.

Standard Error = 0.26

Table 81. CALCIUM CHLORIDE TES SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	—	—	—	
• Air Pollution				
CO	—	—	—	
NO_x	—	—	—	
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Others	—	—	—	
• Noise	0	0	0	if fan is required
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	Less toxic than NaCl

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

Sodium Sulfate Annual O&M Cost (SSMC)

$$SSMC = 5.3\% \text{ of total installed cost} \qquad (48)$$

Standard Deviation = 0.28%

Volume of Sodium Sulfate System (VSSS)

$$VSSS = 0.68 - 0.60 \log(\log x) \qquad (49)$$

where VSSS is in cubic feet per thousand Btu capacity, or size.

Standard Error = 0.18

Weight of Sodium Sulfate System (WSSS)

$$WSSS = 45.32 - 42.32 \log(\log x) \qquad (50)$$

where WSSS is in pounds per thousand Btu capacity, or size.

Standard Error = 9.39

Values predicted by the above equations are shown is Table 82, as a function of size. Plots of the equations are shown in Figures 45 through 48.

Data on efficiency, lifetime, and charge/discharge times did not correlate with system size.

Efficiency

No efficiency data were found in the literature. A total system efficiency of 95% is expected.

Lifetime

Twenty-year lifetimes are reported. One thousand cycles have been experimentally demonstrated. Manufacturers offer warranties ranging from 2 to 5 yrs.

Charge/Discharge Time

Charge times are reported to range from 3 to 10 hr. Discharge times range from 6 to 8 hr.

Mobility

These systems are mobile.

Availability of Raw Materials

Anhydrous sodium sulfate is widely available as a bulk material at about 3¢ per pound.

Table 82. VALUES OF THE SODIUM SULFATE PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

System Capacity, or Size, Btu	(Equation 47) Installed Cost of the Sodium Sulfate System, \$/k Btu (± 0.26)	(Equation 48) Annual O&M Cost, % of Total Installed Cost (± 0.28)	(Equation 49) Volume of the Sodium Sulfate System, ft^3/k Btu (± 0.18)	(Equation 50) Weight of the Sodium Sulfate System lbs/k Btu (± 9.39)
50,000	15.52	5.3	0.28	16.88
100,000	13.57	5.3	0.26	15.74
250,000	11.16	5.3	0.24	14.33
500,000	9.45	5.3	0.23	13.33
1,000,000	7.83	5.3	0.21	12.39
5,000,000	4.37	5.3	0.18*	10.36

* This extrapolated value should be used with caution because it is equal to the standard error of the estimate.

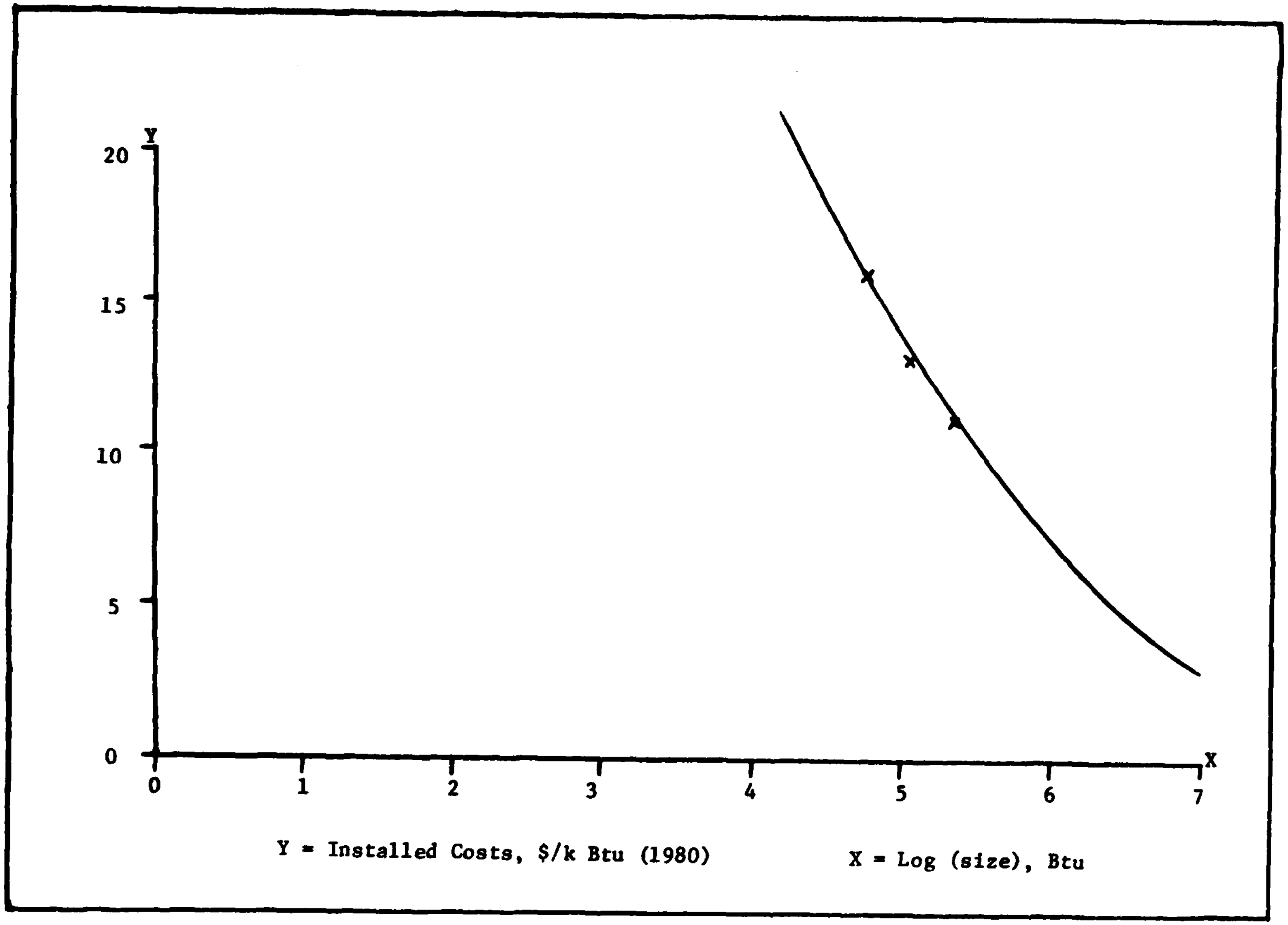

Figure 45. INSTALLED COST OF SODIUM SULFATE TES SYSTEMS

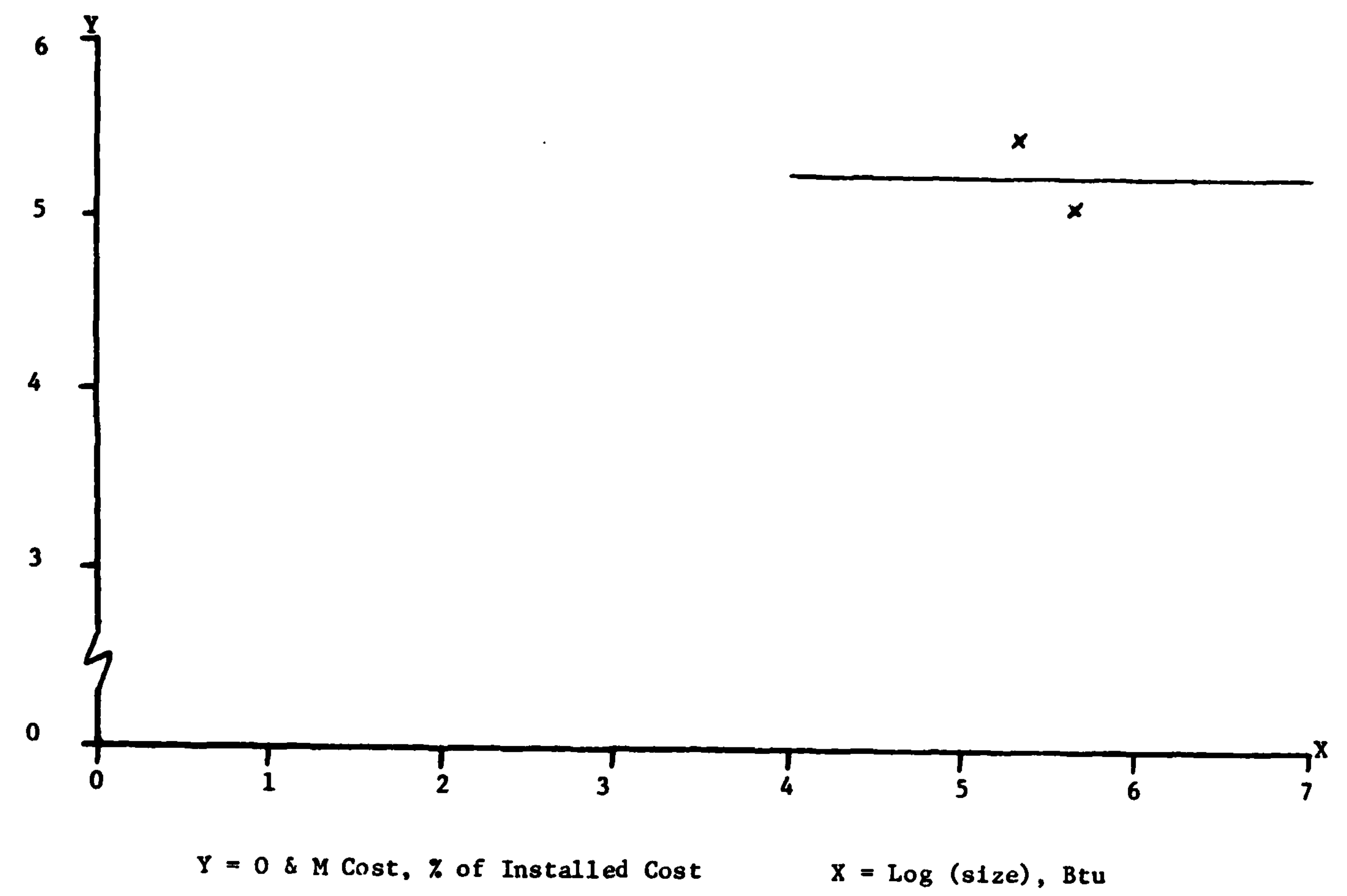

Figure 46. ANNUAL O&M COST OF SODIUM SULFATE TES SYSTEMS

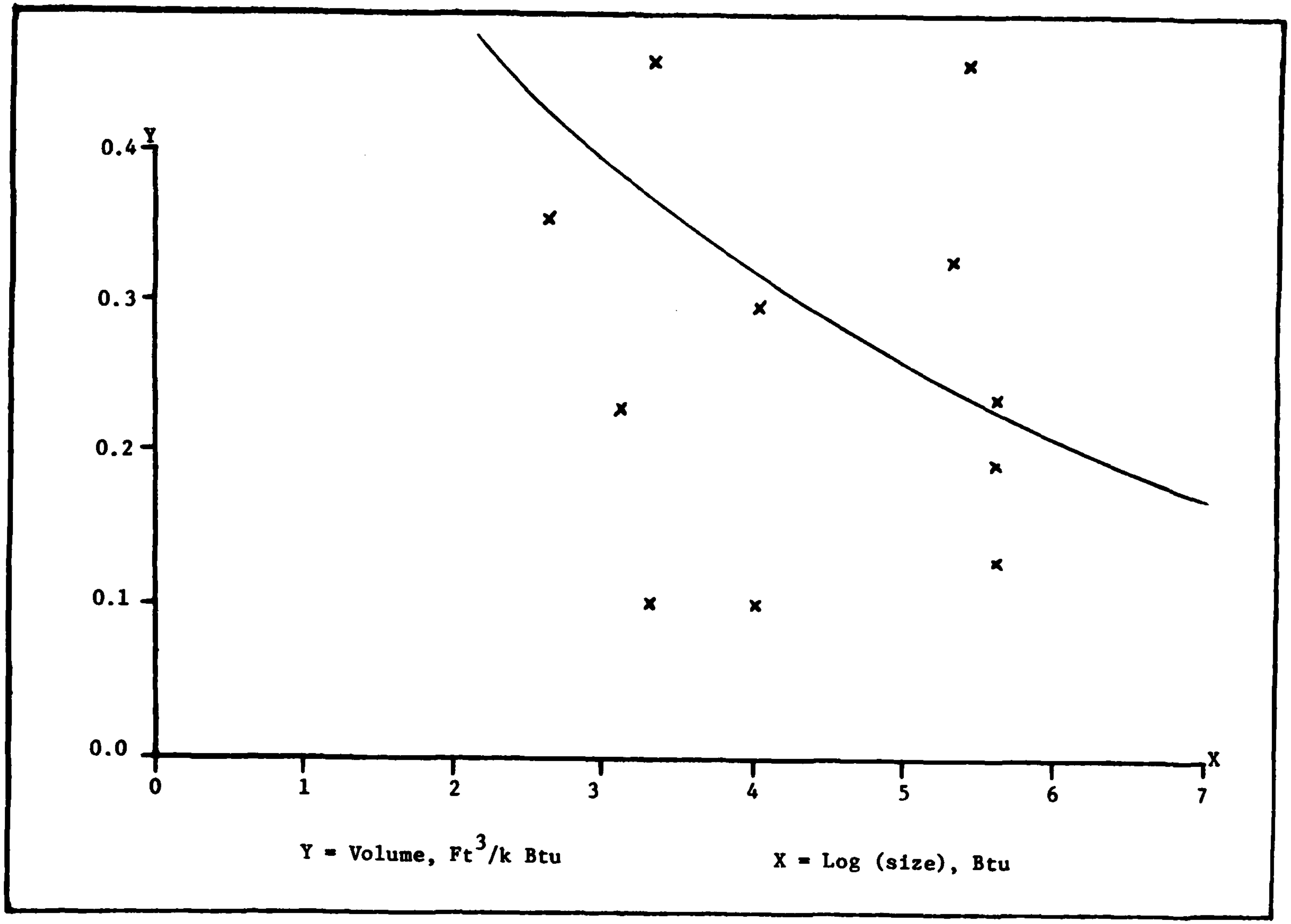

Figure 47. VOLUME OF SODIUM SULFATE TES SYSTEMS

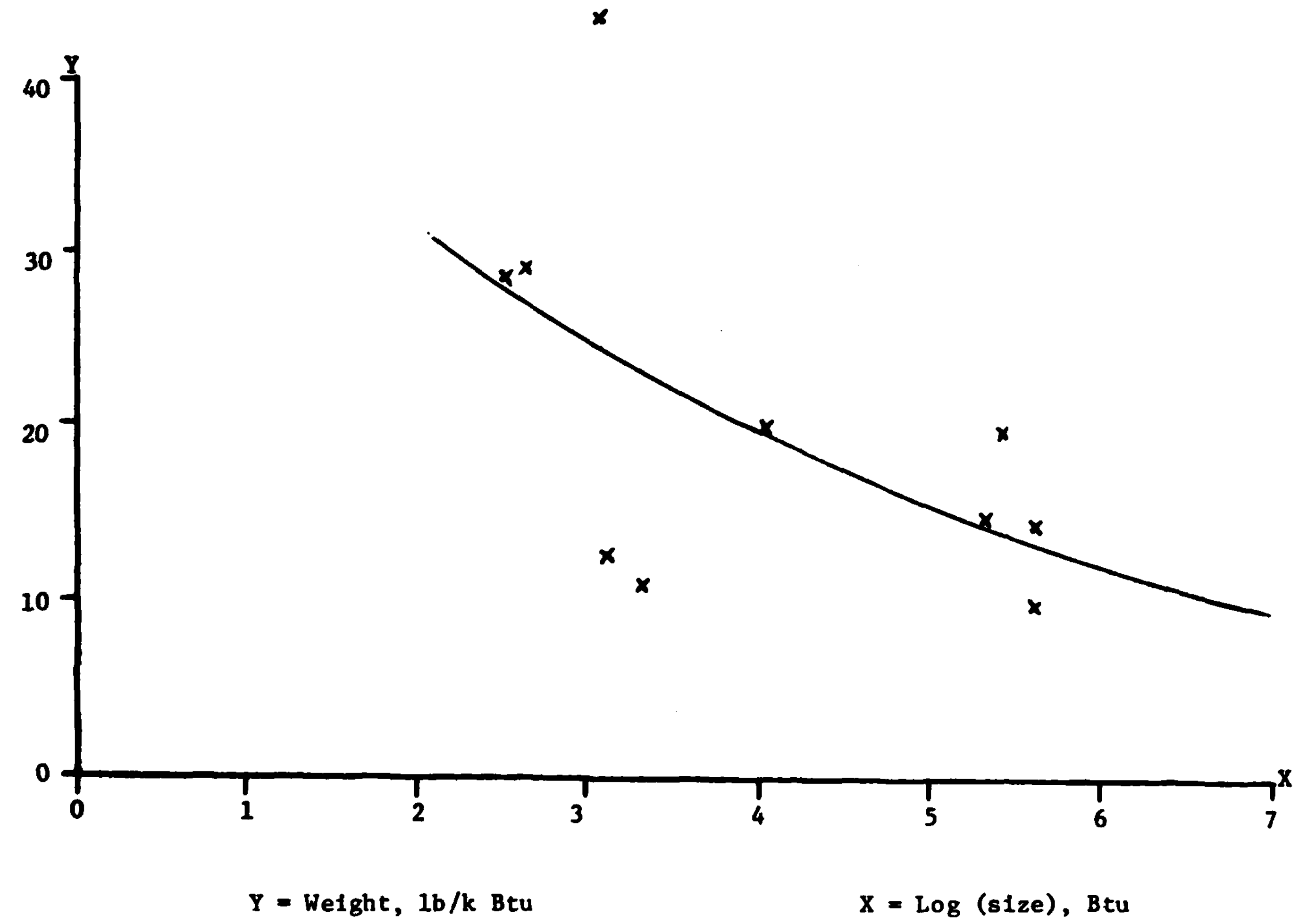

Figure 48. WEIGHT OF SODIUM SULFATE TES SYSTEMS

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 83, 84, 85, and 86, respectively.

Sodium Thiosulfate Pentahydrate

Very little information could be found for this medium and parameters could not be related to size. Much data was assumed to be analogous to the other phase-change media. No commercial manufacturer of systems employing this salt were discovered.

Efficiency

An efficiency of 95% was reported, which seems a reasonable overall efficiency.

Lifetime

An assumed lifetime of 20 years appears in the literature.

Sodium Thiosulfate Installed Cost (STIC)

$$STIC = 44.47 - 51.58 \log (\log x) \qquad (51)$$

where STIC is in dollars per thousand Btu capacity, or size, and x is in Btu. An average cost for one capacity (400,000 Btu) was found in the literature; shape of the curve was assumed similar to that of calcium chloride hexahydrate.

Standard Deviation = 3.01

This equation is plotted in Figure 49.

Sodium Thiosulfate Annual O&M Cost (STMC)

$$STMC = 13\% \text{ of total installed cost} \qquad (52)$$

Standard Deviation not determinable (only one data point)

Volume of Sodium Thiosulfate System (VSTS)

$$VSTS = 0.13 \qquad (53)$$

where VSTS is in cubic feet per thousand Btu capacity, or size.

Standard Deviation not determinable (one data point)

Table 83. SODIUM SULFATE TES SYSTEM LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirement	--	
2. Manning Requirements	--	
3. Fuel Availability and Delivery	◓	Electricity may be required for fan or charging.
4. Fuel Storage	--	
5. Other	0	Some systems utilize passive solar gain.

Overall Assessment: The ordinal score is 4 indicating moderate locational constraints.

Table 84. SODIUM SULFATE TES SYSTEM OPERATION CONSTRAINTS

Constraint	Effects	Remarks
1. Part-Load Capability	--	
2. Overload Capability	◓	Maximum temperature limitations.
3. Load Following Capability	◓	Able to follow minor load changes.

Overall Assessment: The ordinal score is 3 indicating average turn-down capability.

Table 85. SODIUM SULFATE TES SYSTEM RELIABILITY CONSTRAINTS

Constraint	Effects	Remarks
1. Moving Parts	0	
2. Operating Temperature	0	
3. Modularity of the Design	--	
4. Stress Levels	0	Heat-Pack concept has low loading (5 lbs_f/ft^2)
5. Corrosion	◓	Corrosive salt requires adequate containment
6. Other	--	

Overall Assessment: The ordinal score is 4 indicating moderate reliability.

Table 86. SODIUM SULFATE TES SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	—	—	—	
• Air Pollution				
CO	—	—	—	
NO_x	—	—	—	
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Others	—	—	—	
• Noise	0	0	0	If fan is required
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 5 indicating minimum environmental constraint.

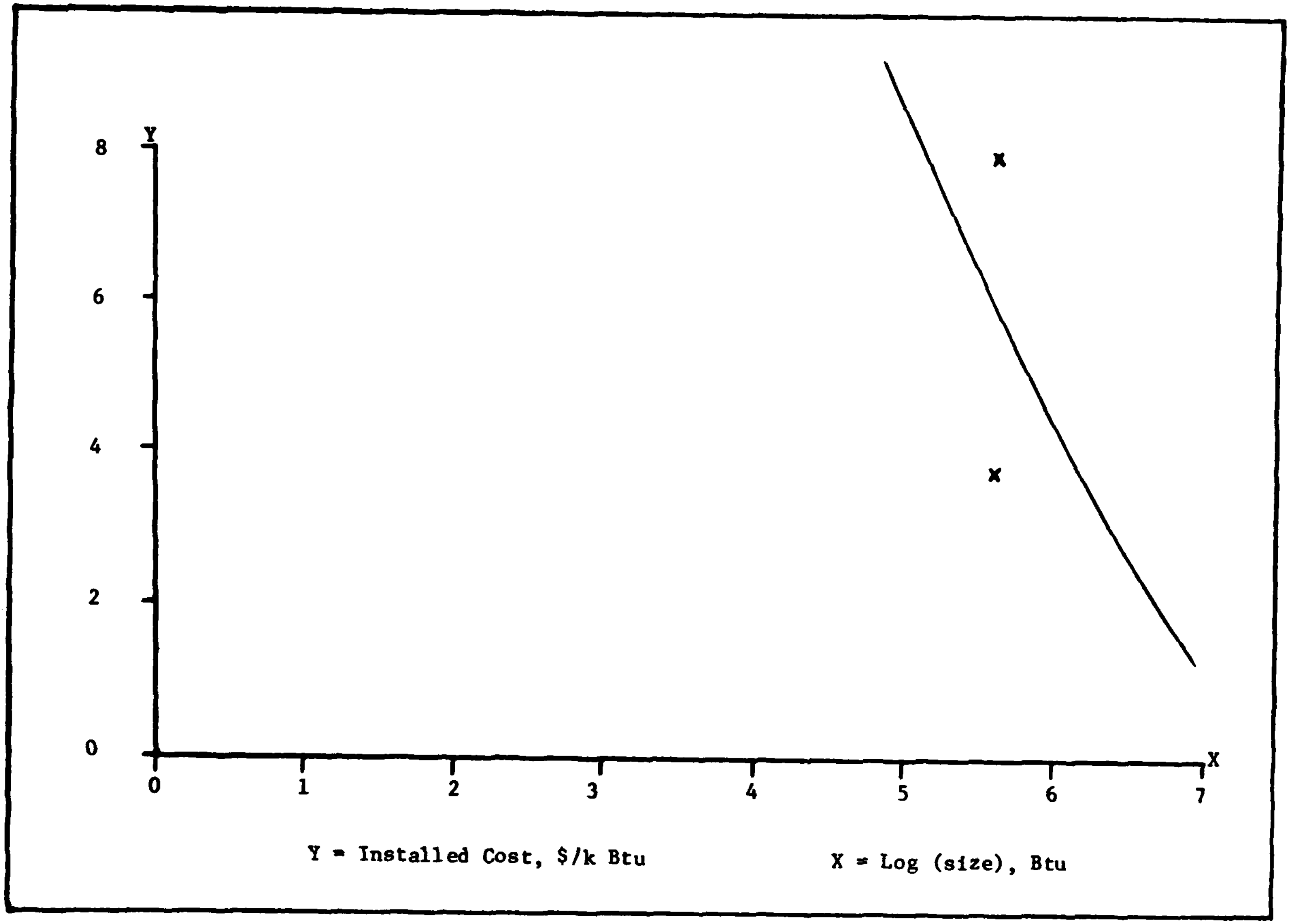

Figure 49. INSTALLED COST OF SODIUM THIOSULFATE TES SYSTEMS

Weight of Sodium Thiosulfate System (WSTS)

$$WSTS = 11.5 \quad (54)$$

where WSTS is in pounds per thousand Btu capacity, or size.

Standard Deviation not determinable (one data point)

Values predicted by the above equations are shown in Table 87, as a function of size.

Charge/Discharge Time

No data was found for this parameter. Reasonable values are represented by the times for sodium sulfate: three to 10-hr charge times and 6 to 8 hr discharge times.

Mobility

These systems should be mobile.

Availability of Raw Material

Sodium thiosulfate is about six times costlier than sodium sulfate and presumably less available.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 88, 89, 90, and 91, respectively.

Form-Stable Polyethylene

Certain cross-linked polyethylenes retain their shape during a phase change and thus appear as good candidates for storing thermal energy with minimal containment problems. This phase change takes place at 240° to 280°F, and is well-suited to absorbtion air conditioning applications. The technology is at the research stage; little information was found in the literature.

Form-Stable Polyethylene Installed Cost (FPIC)

$$FPIC = 50.66 - 7.32 \log x \quad (55)$$

where FPIC is in dollars per thousand Btu capacity, or size, and x = size in Btu.

Standard Error = 1.59

Table 87. VALUES OF THE SODIUM THIOSULFATE PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

System Capacity, or Size, Btu	(Equation 51) Installed Cost of the Sodium Thiosulfate System, \$/k Btu (± 3.01)	(Equation 52) Annual O&M Cost, % of Installed Cost (± undetermined)	(Equation 53) Volume of the Sodium Thiosulfate System, ft^3/k Btu (± undetermined)	(Equation 54) Weight of the Sodium Sulfate System, lbs/k Btu (± undetermined)
50,000	9.81	13	0.13	11.5
100,000	8.42	13	0.13	11.5
250,000	6.70	13	0.13	11.5
500,000	5.49	13	0.13	11.5
1,000,000	4.33	13	0.13	11.5
5,000,000	1.86*	13	0.13	11.5

* This extrapolated value should be used with caution because it is less than the standard deviation of the estimate.

Table 88. SODIUM THIOSULFATE TES SYSTEM LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirement	--	
2. Manning Requirements	--	
3. Fuel Availability and Delivery	●	Electricity may be required for fan, pump or charging.
4. Fuel Storage	--	
5. Other	0	Some systems utilize passive solar gain.

Overall Assessment: The ordinal score is 4 indicating moderate locational constraints.

Table 89. SODIUM THIOSULFATE TES SYSTEM OPERATION CONSTRAINTS

Constraint	Effects	Remarks
1. Part-Load Capability	--	
2. Overload Capability	0	
3. Load Following Capability	●	Able to follow minor load changes.

Overall Assessment: The ordinal score is 4 indicating moderate turn-down capability, moderate efficiency penalty.

Table 90. SODIUM THIOSULFATE TES SYSTEM RELIABILITY FACTORS

Constraint	Effects	Remarks
1. Moving Parts	0	
2. Operating Temperature	0	
3. Modularity of the Design	●	
4. Stress Levels	0	
5. Corrosion	●	Salt is corrosive
6. Other	0	Thermal cycling

Overall Assessment: The ordinal score is 3 indicating average reliability.

Table 91. SODIUM THIOSULFATE TES SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	—	—	—	
• Air Pollution				
CO	—	—	—	
NO_x	—	—	—	
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Others	—	—	—	
• Noise	0	0	0	If fan or pump is used
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	0	0	0	Potential for leaks

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

Efficiency

Efficiency ranges from 90% to about 100%; 95% is a reasonable estimate of total system efficiency.

Lifetimes

Reported lifetimes range from 20 to 30 yr with 25 years as the median.

Annual O&M Cost (FSMC)

$$\text{FSMC} = 3\% \text{ of total capital cost} \tag{56}$$

Standard Deviation = 2.8%

Volume of Form-Stable Polyethylene System (VFSS)

$$\text{VFSS} = 0.198 \tag{57}$$

where VFSS is in cubic feet per thousand Btu capacity, or size

Standard Deviation = 0.072

Weight of Form-Stable Polyethylene System (WFSS)

$$\text{WFSS} = 12.1 \tag{58}$$

where WFSS is in pound per thousand Btu capacity, or size.

Standard Deviation = 4.45

Values predicted by the equations above are shown in Table 92, as a function of size.

Charge/Discharge Time

One charge time was was reported as 13 hr and discharge time ranged from 4 to 8 hr.

Mobility

These systems should be mobile.

Availability of Raw Material

Most ethylene is currently produced from petroleum, and natural gas, which are becoming increasingly dear. Ethylene can also be manufactured from coal, of which the U.S. has a large supply.

Other Parameters

Locational and operational constraints, reliability, and environmental factors are presented in Tables 93, 94, 95, and 96, respectively.

Table 92. VALUES OF FORM-STABLE POLYETHYLENE PARAMETERS AS PREDICTED FROM THE DEVELOPED MATHEMATICAL FUNCTIONS

System Capacity, or Size, Btu	(Equation 55) Installed Cost of the Form-Stable Polyethylene System, \$/k Btu (±1.59)	(Equation 56) Annual O&M Cost, % of Installed Cost (± 2.8)	(Equation 57) Volume of the Form-Stable Polyethylene System, ft^3/k Btu (± 0.072)	(Equation 58) Weight of the Form-Stable Polyethylene System lbs/k Btu (± 4.45)
50,000	16.24	3	0.198	12.1
100,000	14.03	3	0.198	12.1
250,000	11.12	3	0.198	12.1
500,000	8.92	3	0.198	12.1
1,000,000	6.71	3	0.198	12.1
5,000,000	1.59*	3	0.198	12.1

* This extrapolated value should be used with caution because it is equal to the standard error of the estimate.

Table 93. FORM-STABLE POLYETHYLENE TES
LOCATION CONSTRAINTS

Constraint	Effects	Remarks
1. Water Requirement	--	
2. Manning Requirements	--	
3. Fuel Availability and Delivery	●	Electricity may be required for fan or charging.
4. Fuel Storage	--	
5. Other	O	Some systems utilize active solar equipment.

Overall Assessment: The ordinal score is 4 indicating moderate locational constraints.

Table 94. FORM-STABLE POLYETHYLENE TES SYSTEM
OPERATION CONSTRAINTS

Constraint	Effects	Remarks
1. Part-Load Capability	O	
2. Overload Capability	●	
3. Load Following Capability	●	

Overall Assessment: The ordinal score is 3 indicting average turn-down capacity.

Table 95. FORM-STABLE POLYETHYLENE TES SYSTEM
RELIABILITY FACTORS

Constraint	Effects	Remarks
1. Moving Parts	O	
2. Operating Temperature	O	
3. Modularity of the Design	●	
4. Stress Levels	O	
5. Corrosion	--	
6. Other	O	Thermal cycling

Overall Assessment: The ordinal score is 4 indicating moderate reliability.

Table 96. FORM-STABLE POLYETHYLENE TES SYSTEM ENVIRONMENTAL CONSTRAINTS

Constraint	Amount of Uncontrolled Emissions	Amount of Emissions With Controls	Degree of Difficulty In Meeting More Stringent Regulations	Remarks
• Thermal Discharge	—	—	—	
• Air Pollution				
CO	—	—	—	
NO_x	—	—	—	
SO_x	—	—	—	
HC	—	—	—	
Particulates	—	—	—	
Others	—	—	—	
• Noise	0	0	0	Pump or fan noise.
• Odor	—	—	—	
• Solid Waste	—	—	—	
• Chemical Waste	—	—	—	

Overall Assessment: The ordinal score is 5 indicating minimum potential environmental constraint.

THERMAL ENERGY STORAGE SYSTEMS

Raw Data

DATA SHEET

Energy Conversion System: Olivine Ceramic Brick Storage Resistance Heating, TES

Parameter: Efficiency

Energy Conversion System Ref.	**Parameter Value** Study	Operating Plant	**Plant Size, kW**	**Assumptions of Advanced State of the Art**
TES-1	∿100%		20 to 30 (680,000 to 1,000,000 Btu)	None

DATA SHEET

Energy Conversion System: Olivine TES

Parameter: Weight

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-14		1400 lbs	400,000	

DATA SHEET

Energy Conversion System: Olivine TES

Parameter: Startup/Shutdown Time

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-[illegible]	10 hr discharge time		20-30 (680,000 to 1 million Btu)	None
TES-14	4.7 hr discharge time		12 (400,000 Btu)	

DATA SHEET

Energy Conversion System: Olivine TES

Parameter: OCM Cost (Annual, 1980 $)

Energy Conversion System Ref.	Parameter Value* Study	Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-1	$1380		30(10^6 Btu)	None
"	1040		25(850,000 Btu)	"
"	600		20(680,000 Btu)	"

*based on 40 mill/kWh

DATA SHEET

Energy Conversion System: Olivine TES

Parameter: Acquisition Cost (1980 $)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-1	2020		20(680,000 Btu)	None
"	2240		25(850,000 Btu)	
"	2440		30(1 million Btu)	
TES-14	1290		12(400,000 Btu)	

DATA SHEET

Energy Conversion System: Olivine TES

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Frequency of Operation	Assumptions of Advanced State of the Art
TES-1	20 yrs		20-30 (680,000 to 1 million Btu)		None

DATA SHEET

Energy Conversion System: Magnesite Brick Forced-Air Electric Furnace

Parameter: Efficiency

Energy Conversion System Ref.	**Parameter Value**		**Plant Size, kWh**	**Assumptions of Advanced State of the Art**
	Study	**Operating Plant**		
TES-16		Very Small Stand-by	40-240 = 140,000-820,000 Btu	None

DATA SHEET

Energy Conversion System: Magnesite Brick

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-4		2.9 ft x 5.7 ft x 5.6 ft high (= 93 ft^3)	22 (750,000 Btu)	None
TES-5		25' x 25' x 350' = 220,000 ft^3	5.2×10^9 Btu	
TES-17		1 ft^3	1100 Btu	
TES-16		1 ft^3	2-6 kWh	

DATA SHEET

Energy Conversion System: Magnesite Brick

Parameter: Weight

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-4		2570 lbs (bricks only)	22 (750,000 Btu)	None
TES-5	15,000 tons = 30 million #		5.2×10^9 Btu	
TES-17		158 lbs	1100 Btu	
TES-16		20-25 lbs	1 kWh (3400 Btu)	

DATA SHEET

Energy Conversion System: Magnesite Brick

Parameter: Acquisition Cost

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-4		\$4500 (Canadian) x 0.80 US\$/C\$ = \$3600	22 kW x 10 hrs → 220 kWh (750,000 Btu)	None; mass production should lower costs to \$600-\$700 above conventional furnace)
TES-5	\$42.9 million		5.2×10^9 Btu	
TES-16		\$1200	38 kWh (130,000 Btu)	Swiss & German fan storage radiators, installed
DO		\$1400	60 kWh (200,000 Btu)	English cenral fan storage installed

DATA SHEET

Energy Conversion System: Magnesite Brick

Parameter: Charge/Discharge

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-4		10 hr charge 14 hr discharge	22 (750,000 Btu)	None
TES-4		8 hr charge 6 hr discharge	5.2×10^9 Btu	
TES-16		8 hr charge 13-16 hr discharge	– –	

TES
DATA SHEET

Energy Conversion System: Calcium Chloride Hexahydrate

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-18		82% (charging) 99% (discharging)	26,800 21,700	Test unit only; larger plants may have higher efficiency
TES-18		97% (discharging)	300,000	Computer prediction

DATA SHEET

Energy Conversion System: Calcium Chloride Hexahydrate, TES

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-13	300 gal. of salt = 40 ft^3		300,000	None
TES-19		6'X5'X3' = 90 ft^3	330,000	None
TES-18	4.5'X2.9'X0.83' = 11 ft^3		24,300	Test only
TES-18	2.9'X5.75'X6' = 100 ft^3		430,000	Conceptual
TES-3	3.9'X3.9'X6.0' = 91 ft^3		400,000	
TES-20		67.5 ft^3	310,000	
TES-22	7"X4.26" diam. = 0.06 ft^3		345	Available now.

DATA SHEET

Energy Conversion System: Calcium Chloride Hexahydrate, TES

Parameter: Weight (lbs)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-13	3945		300,000	–
TES-19	Pace Corp...no sun	4015	415,000	–
TES-18	485 for total system		21,700	–
TES-18	5675 salt + tubes		430,000	
	470 for total system		30,000	
TES-3	7500		400,000	
TES-20		3300	310,000	Includes container weight

DATA SHEET

Energy Conversion System: Calcium Chloride Hexahydrate, TES

Parameter: Charge/Discharge Time

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-19	8-9 hrs charge all night discharge (14 hrs?)		NA	In direct sunlight
TES-18	16.4 hrs charge 12.1 hrs discharge		21,700 26,800	– –
TES-18	36 hrs discharge		428,000	–
TES-20	5 hr charge) 23 hrs discharge)		170,000	

DATA SHEET

Energy Conversion System: Calcium Chloride Hexahydrate, TES

Parameter: O & M Cost

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-19	"Virtually maintenance free"		330,000	—
			415,000	
TES-18	$19		430,000	1% of total capital
	$30		710,000	

DATA SHEET

Energy Conversion System: Calcium Chloride Hexahydrate, TES

Parameter: Acquisition Cost (1980 $)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-13	$2500		300,000	"Inexpensive way of increasing the effective conductance of the PCM or providing multiple conduction paths."
TES-23	$39.95 + freight (FOB Manchester,NH per thermol 81 Rod			
		$4900	300,000	Rods only
TES-18	$3000		710,000	Nucleators work as intended
	$1900		430,000	
TES-3	$1800		400,000	
TES-20		$2800	310,000	

TES
DATA SHEET

Energy Conversion System: Calcium Chloride Hexahydrate

Parameter: Lifetime

Energy Conversion System Ref.	**Parameter Value Study**	**Parameter Value Operating Plant**	**Plant Size, Btu**	**Assumptions of Advanced State of the Art**
TES-19	20-30 yrs (10 yr warranty)		330,000 415,000	Extrapolation of 7 year test
TES-20	1000 cycles ≥ 5 years			5 year experiment
DO	20 yrs		–	Expected, w/90% capacity retention
DO	10 year warranty			
TES-21	30-50 years		–	
TES-22	5 year warranty		345	None

DATA SHEET

Energy Conversion System: Sodium Sulfate Decahydrate (Galuber's Salt) TES

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-3	1 ft^3		10,000	
DO	5'X5'X5' = 125 ft^3		270,000	
DO	1 ft^3		2,160	
DO	16"X16"X20" = 3 ft^3		10,000	Prototype
DO	3.6'X3.6'X6' = 78 ft^3		400,000	
TES-14	6'X2'X5.5' = 66 ft^3		200,000	
DO	385 gal. (space) = 51 ft^3		400,000	
DO	4'X6'X4' = 96 ft^3		400,000	
TES-22	2'X2' (tile) = 0.7 ft^3		1,000	None
DO	2'X1'X2" = 0.3 ft^3		1,294	None
DO	30"X4" diam. = 0.2 ft^3		2,000	
DO	3/4"X2'X2' = 0.25 ft^3		350	None

DATA SHEET

Energy Conversion System: Sodium Sulfate Decahydrate (Glauber's Salt), TES

Parameter: Weight

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-3	5400 lbs		270,000	
DO	200 lbs		10,000	Proto.
DO	5800 lbs		400,000	
TES-14	3000 lbs		200,000	
DO	4000 lbs		400,000	
TES-22	44 lbs		1,000	None
DO	16 lbs		1,294	None
DO	22 lbs		2,000	
DO	10 lbs		350	

TES
DATA SHEET

Energy Conversion System: Sodium Sulfate Decahydrate (Glauber's Salt), TES

Parameter:

Energy Conversion System Ref.	**Parameter Value** Study	Operating Plant	**Plant Size, Btu**	**Assumptions of Advanced State of the Art**
TES-14	8 hrs.		400,000	Discharge
DO	5.7 hrs		200,000	"

DATA SHEET

Energy Conversion System: Sodium Sulfate Decahydrate (Glauber's Salt), TES.

Parameter: O & M Cost (Annual)

Energy Conversion System Ref.	Parameter Value Study	Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-14	$53		400,000	Maintenance only
DO	$39		200,000	Maintenance only

DATA SHEET

Energy Conversion System: Sodium Sulfate Decahydrate (Glauber's Salt), TES

Parameter: Acquisition Cost

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-3	$710		270,000	
DO	$1500		400,000	
TES-14	$970		400,000	
DO	$760		200,000	
TES-24	$2200		600,000	

DATA SHEET

Energy Conversion System: Sodium Sulfate Decahydrate (Glauber's Salt), TES

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-3		200 cycles	lab scale	
TES-14	20 yrs		400,000	Assumed
TES-25		1000 cycles	?	Experiment
TES-22		2 yr warranty	1,000	Tile (none)
DO		5 yr warranty	1,294	None
DO		5 yr warranty	350	None

DATA SHEET

Energy Conversion System: Sodium Thiosulfate Pentahydrate, TES

Parameter: Efficiency

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-3	95.1%		—	—

DATA SHEET

Energy Conversion System: Sodium Thiosulfate Pentahydrate, TES

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-3		2.9'X2.9'X6.0' = 51 ft^3	400,000	

DATA SHEET

Energy Conversion System: Sodium Thiosulfate Pentahydrate, TES

Parameter: Weight (lbs)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-3	4600		400,000	Salt only?

DATA SHEET

Energy Conversion System: Sodium Thiosulfate Pentahydrate, TES

Parameter: O & M Cost (Annual)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-14	$420		400,000	

DATA SHEET

Energy Conversion System: Sodium Thiosulfate Pentahydrate, TES

Parameter: Acquisition Cost

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, kW	Assumptions of Advanced State of the Art
TES-3	$1500		400,000	
TES-14	$3200		400,000	

DATA SHEET

Energy Conversion System: Sodium Thiosulfate Pentahydrate, TES

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-14	20 yrs			Assumed

DATA SHEET

Energy Conversion System: Form-Stable Polyethylene, TES

Parameter: Volume/Size

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-13	440 gal		400,000	Medium and heat transfer fluid only
TES-14	495 gal (∿3.6 diam. X 6' high)		400,000	

DATA SHEET

Energy Conversion System: Form-Stable Polyethelene, TES

Parameter: Weight (lbs)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-13	3800		400,000	Includes heat transfer fluid and medium only
TES-14	3800		400,000	

DATA SHEET

Energy Conversion System: Form-Stable Polyethelene, TES

Parameter: Charge/Discharge Time

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-14	8 hrs.		400,000	

DATA SHEET

Energy Conversion System: Form-Stable Polyethelene, TES

Parameter: O & M Cost (Annual)

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Assumptions of Advanced State of the Art
TES-14	$210		400,000	

DATA SHEET

Energy Conversion System: Form-Stable Polyethylene, TES

Parameter: Acquisition Cost

Energy Conversion System Ref.	**Parameter Value Study**	**Parameter Value Operating Plant**	**Plant Size, Btu**	**Assumptions of Advanced State of the Art**
TES-13	$3400 (system)		400,000	Successful scale-up of P[illegible]
TES-14	$4300		400,000	Medium cost of 33¢/lb at production $\geq$ 10,000,000 lb/yr

DATA SHEET

Energy Conversion System: Form-Stable Polyethylene, TES

Parameter: Lifetime

Energy Conversion System Ref.	Parameter Value Study	Parameter Value Operating Plant	Plant Size, Btu	Frequency of Operation, Per Year	Assumptions of Advanced State of the Art
TES-13	20 yrs		400,000	150	Successful scale-up of PDU
TES-14	20 yrs		400,000		

THERMAL ENERGY STORAGE SYSTEMS

Bibliography

TES-1

ACCESSION NO. [illegible]
TITLE (MONO) DISTRIBUTED THERMAL ENERGY STORAGE IN THE RESIDENTIAL SECTOR: COMMERCIALIZATION-READINESS ASSESSMENT AND IMPLEMENTATION STRATEGY
CORPORATE AUTH DEPARTMENT OF ENERGY, WASHINGTON, DC (USA). ASSISTANT SECRETARY FOR CONSERVATION AND SOLAR ENERGY
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PRIMARY CAT EDB-32[illegible]
REPORT NO DOE/CS-[illegible]
ABSTRACT THE READINESS OF EACH OF THREE CANDIDATE TES SYSTEMS FOR NEAR-TERM COMMERCIALIZATION WAS EXAMINED. IT WAS CONCLUDED THAT OF THESE, TES FOR RESIDENTIAL SPACE AND HOT-WATER HEATING ARE TECHNICALLY AND ECONOMICALLY READY FOR COMMERCIALIZATION. TES SYSTEMS ARE UNLIKELY TO BE MORE ATTRACTIVE THAN STANDARD-HEAT-PUMP SYSTEMS IN ALL AREAS OF THE COUNTRY; HOWEVER, IN MANY REGIONS, PARTICULARLY IN THE NORTHEAST AND NORTH CENTRAL STATES, TES APPEARS TO BE MORE ATTRACTIVE. IN THE NOT-TOO-DISTANT FUTURE, USE OF TES WITH HEAT PUMPS MAY PROVE TO BE THE BEST SYSTEM NATIONWIDE. FOR THE THIRD SYSTEM, TES FOR RESIDENTIAL SPACE COOLING, IT WAS FOUND THAT THOSE UNITS THAT ARE PRESENTLY TECHNICALLY VIABLE WOULD BE TOO COSTLY EXCEPT IN A FEW PARTS OF THE COUNTRY; MORE DEVELOPMENT WILL BE REQUIRED BEFORE THESE SYSTEMS COULD BE COMMERCIALIZED ON A NATIONAL SCALE. TES SYSTEMS THAT MIGHT BE USED IN COMMERCIAL BUILDINGS (E.G., STORES AND OFFICE BUILDINGS) WERE NOT EXAMINED. ENVIRONMENTAL, MARKET AND ECONOMIC, AND INSTITUTIONAL-READINESS STUDIES ARE PRESENTED. MARKET PENETRATION AND BENEFIT ANALYSIS ARE SUMMARIZED. BARRIERS TO COMMERCIALIZATION ARE IDENTIFIED ALONG WITH STRATEGIES FOR OVERCOMING THE BARRIERS. SCHEDULES AND RESOURCE REQUIREMENTS ARE DISCUSSED. SUMMARIES OF THE STUDY TECHNIQUES AND ADDITIONAL INFORMATION ARE GIVEN IN THE APPENDICES. (MCW)
DESCRIPTORS COMMERCIALIZATION: Q1;COMPARATIVE EVALUATIONS;COOLING SYSTEMS: T5;COST BENEFIT ANALYSIS;ENVIRONMENTAL IMPACTS;EVALUATION;HEAT PUMPS;HOT WATER;INSTITUTIONAL FACTORS;MARKETING RESEARCH; PAYBACK PERIOD;RECOMMENDATIONS;RESIDENTIAL BUILDINGS: T1;SPACE HEATING: T4;TECHNOLOGY ASSESSMENT;THERMAL ENERGY STORAGE EQUIPMENT: [illegible];WATER HEATERS: T5

TES-2

ACCESSION NO. [illegible]
TITLE (MONO) THERMAL ENERGY STORAGE SUBSYSTEMS FOR SOLAR HEATING AND COOLING APPLICATIONS: ROLLING CYLINDER THERMAL STORAGE. INTERIM REPORT
EDITOR OR COMP THORNTON, R.F., HERRICK, C.S.
CORPORATE AUTH GENERAL ELECTRIC CO., SCHENECTADY, NY (USA)
PAGE NO 119
AVAILABILITY DEP. NTIS, PC A06/MF A01.
CONTRACT NO CONTRACT [illegible]
DATE JUL 197[illegible]
CATEGORIES EDB-14[illegible]
PRIMARY CAT EDB-142000
REPORT NO [illegible]--5759-T1
ABSTRACT THE ROLLING CYLINDER PROVIDES A MEANS FOR UTILIZING THE LATENT HEAT OF FUSION OF SALT HYDRATES FOR THERMAL ENERGY STORAGE. CALORIMETRIC TESTS OF LABORATORY SCALE ROLLING CYLINDERS USING GLAUBER'S SALT HAVE CONFIRMED THE TECHNICAL FEASIBILITY OF THE CONCEPT. SEVERAL CONCEPTS FOR LARGE SCALE, ONE MILLION BTU, UNITS HAVE BEEN EVALUATED FOR HEAT RATE CAPABILITY, BLOWER AND ROLLING POWER REQUIREMENTS, AND RELATIVE COST AND MANUFACTURABILITY. LARGE SCALE UNITS SEEMS TECHNICALLY AND ECONOMICALLY VIABLE. CONSTRUCTION OF A LARGER SCALE PROTOTYPE IS PLANNED FOR THE NEXT PART OF THIS CONTRACT. THE RECOMMENDED SIZE OF THE PROTOTYPE IS A TWO-FOOT DIAMETER, NINE-FOOT LONG CYLINDER OF ABOUT 250,000 BTU THEORETICAL CAPACITY. AN INSTRUMENTED CALORIMETER WOULD BE CONSTRUCTED FOR TESTING OF THE CYLINDER. A ONE-YEAR TESTING PHASE IS TENTATIVELY PLANNED AS A FOLLOW-ON TO THE PRESENT CONTRACT.
DESCRIPTORS CALORIMETERS;CYLINDERS;HYDRATES;LATENT HEAT STORAGE: T1; PERFORMANCE TESTING: Q1;ROTATION;SODIUM SULFATES;SOLAR COOLING SYSTEMS;SOLAR HEATING SYSTEMS;THERMAL ENERGY STORAGE EQUIPMENT: T1

TES-3

ACCESSION NO. 79C0040734
TITLE (MONO) SALT HYDRATES AND OTHER PHASE-CHANGE MATERIALS
EDITOR OR COMP CANTOR, S.
CORPORATE AUTH OAK RIDGE NATIONAL LAB., TN (USA)
PAGE NO 1[illegible]
AVAILABILITY DEP. NTIS, PC A02/MF A01.
CONTRACT NO CONTRACT W-7405-ENG-26
CONF TITLE 3. ANNUAL THERMAL ENERGY STORAGE CONTRACTOR'S INFORMATION EXCHANGE MEETING
CONF PLACE SPRINGFIELD, VA, USA
CONF DATE 5 DEC 1978
DATE 1978
CATEGORIES EDB-250600
PRIMARY CAT EDB-250600
REPORT NO CONF-781231--1
ABSTRACT THE OBJECTIVES OF THE PROJECT ARE: TO ASCERTAIN THERMAL PERFORMANCE OF NA2SO4 .10H2O AND OTHER INCONGRUENTLY MELTING SALT HYDRATES BY CALORIMETRIC INVESTIGATION OF MELTING AND FREEZING; AND SELECT COMPOUNDS AND MIXTURES SUITABLE FOR ISOTHERMAL HEAT STORAGE WITHIN THE RANGE, 90 TO 250 DEGC. SELECTION IS TO BE BASED ON LABORATORY EVALUATION AS WELL AS ON ECONOMIC AND TECHNICAL SCREENING CRITERIA.
DESCRIPTORS ECONOMICS;HYDRATES;LATENT HEAT STORAGE: Q2;PERFORMANCE TESTING: Q1;SODIUM SULFATES: T2;THERMAL ENERGY STORAGE EQUIPMENT: T1

TES-4

ACCESSION NO. [illegible]
TITLE THERMAL ENERGY STORAGE IN FORCED-AIR ELECTRIC FURNACES
AUTHORS CLARE, [illegible]; MANDY, K.M.S.; SULATISKY, M.T.
AUTHOR AFF SASK POWER CORP, REGINA
PUB DESC IEEE TRANS. IND. APPL., V. IA-16, NO. 1, PP. 127-133
DATE JAN-FEB 1980
CATEGORIES EDB-320101;[illegible]
PRIMARY CAT EDB-320101
ABSTRACT EXPERIMENTAL DATA ARE PRESENTED FOR HEAT STORAGE IN FORCED-AIR ELECTRIC FURNACES USING MAGNESITE AS THE HEAT STORAGE MATERIAL. CHARGE AND DISCHARGE DATA FOR TEMPERATURE AND FLOW, OBTAINED IN THE LABORATORY, ARE COMPARED WITH MODELS USED FOR THE DESIGN OF THE FURNACE. EXPERIENCE WITH THE FURNACE OPERATING IN HOMES FOR A HEATING SEASON AND BEING CHARGED DURING THE OFF PEAK IS ALSO PRESENTED. A DESCRIPTION OF THE FURNACE AND THE CONTROL SYSTEM USED TO CONTROL AIR FLOW AND TEMPERATURE IS GIVEN ALONG WITH A BRIEF SUMMARY OF COST AND MARKET POTENTIAL. THE CAPABILITY OF SODIUM SULFATE BRICKS AS A REPLACEMENT FOR THE MORE EXPENSIVE MAGNESITE BRICKS IS SUMMARIZED. THE RESULTS OF CYCLING TESTS THAT SHOW ITS IMPROVED MECHANICAL STRENGTH WITH THE ADDITION OF BINDER MATERIALS ARE DISCUSSED. 10 REFS.
DESCRIPTORS BRICKS;CONTROL SYSTEMS;COST;ELECTRIC FURNACES: T2;HOUSES: T1; MARKET;OPERATION: U3;SPACE HEATING: U1;THERMAL ENERGY STORAGE EQUIPMENT: U2,T3

TES-5

ACCESSION NO. 80U0027427
TITLE(MONO) SENSIBLE HEAT STORAGE FOR A SOLAR THERMAL POWER PLANT
EDITOR OR COMP BALDWIN, T.F.; LYNN, S.; FOSS, A.S.
CORPORATE AUTH CALIFORNIA UNIV., BERKELEY (USA). LAWRENCE BERKELEY LAB.
PAGE NO [illegible]
AVAILABILITY DEP. NTIS, PC A09/MF A01.
CONTRACT NO CONTRACT W-7405-ENG-48
DATE JUL 1979
GROUP NOTE THESIS
CATEGORIES EDB-140702;[illegible]
PRIMARY CAT EDB-140702
REPORT NO. LBL--[illegible]
ABSTRACT THIS REPORT EXAMINES ONE POSSIBLE CONFIGURATION FOR A SOLAR POWER PLANT WITH A SENSIBLE-HEAT STORAGE UNIT. THE PROPOSED FLOWSHEET ALLOWS THERMAL ENERGY STORAGE BETWEEN THE HEAT COLLECTION UNIT AND THE POWER GENERATION UNIT WITHOUT A REDUCTION IN THE THERMODYNAMIC AVAILABILITY OF THE ENERGY SUPPLIED TO THE POWER TURBINES. ENERGY IS STORED BY HEATING A CHECKERWORK OF MAGNESIA BRICKS. A GAS THAT IS CIRCULATED FROM THE SOLAR COLLECTOR THROUGH THE STORAGE UNIT AND THE POWER PLANT BOILER SERVES AS THE HEAT-TRANSFER MEDIUM. NITROGEN WAS FOUND TO BE PREFERABLE TO HELIUM FOR THIS PURPOSE. A COMPUTER MODEL WAS USED TO PREDICT THE BEHAVIOR OF THE SENSIBLE-HEAT STORAGE UNIT AND TO AID IN SIZING THE STORAGE UNIT. PROCEDURES WERE DEVELOPED TO ESTIMATE THE COST OF ELECTRICITY GENERATED BY THE SOLAR POWER PLANT. THESE PROCEDURES ILLUSTRATE THE EFFECTS OF CHANGES IN THE ENERGY STORAGE UNIT ON THE COST OF ELECTRICITY. THE EFFECTS ON THE STORAGE UNIT AND ON THE TOTAL PLANT DESIGN OF CHANGING SEVERAL PROCESS AND DESIGN PARAMETERS WERE THEN EVALUATED. THIS STUDY HAS LED TO THE DESIGN OF TWO ALTERNATIVE PROCESS CONFIGURATIONS FOR SOLAR POWER PLANTS WITH SENSIBLE-HEAT STORAGE. THE SENSIBLE-HEAT STORAGE PROCESS WAS ALSO COMPARED TO THE SULFUR OXIDE CHEMICAL-HEAT STORAGE PROCESS. THE PROPOSED CONFIGURATION FOR A SOLAR POWER PLANT WITH SENSIBLE-HEAT STORAGE FOR NIGHTTIME ELECTRICITY GENERATION PRODUCES ELECTRICITY AT THE COST OF 867 PER MW/SUB E/-HR. BOTH OF THESE POWER PLANTS CONVERT 32% OF THE ENERGY ABSORBED BY THEIR SOLAR COLLECTORS INTO USABLE ELECTRIC ENERGY. IT IS CONCLUDED THAT SENSIBLE-HEAT STORAGE CAN PROVIDE ENERGY STORAGE FOR A SOLAR POWER PLANT AT A REASONABLE PRICE USING TECHNOLOGY THAT IS PRESENTLY AVAILABLE.
DESCRIPTORS BRAYTON CYCLE;BRICKS;CAVITY RECEIVERS;CENTRAL RECEIVERS; COMPARATIVE EVALUATIONS: U1;COMPUTER CALCULATIONS: U1; COMPUTER-AIDED DESIGN;COST;DATA;DESIGN: U1;ECONOMICS;FLOWSHEETS; GASES;HEAT EXCHANGERS;HEAT TRANSFER FLUIDS;HELIUM;MAGNESIUM OXIDES: T2;MATHEMATICAL MODELS;RANKINE CYCLE POWER SYSTEMS; SENSIBLE HEAT STORAGE: U3;SIZE;STEAM TURBINES;SULFUR OXIDES; SYSTEMS ANALYSIS;TANKS;THERMAL ENERGY STORAGE EQUIPMENT: T1;U2; THERMOCHEMICAL HEAT STORAGE;TOPPING CYCLES;TOWER FOCUS POWER PLANTS: T1

TES-6

ACCESSION NO.	79C0000257
REPORT NO.PAGE	CONF-770955 P. 26
TITLE	ENCAPSULATION OF PHASE CHANGE MATERIALS IN CONCRETE MASONRY CONSTRUCTION
AUTHORS	KURACKA, L.E.
AUTHOR AFF	BROOKHAVEN NATIONAL LAB., UPTON, NY
TITLE(MONO)	PROCEEDINGS OF THE SECOND ANNUAL THERMAL ENERGY STORAGE CONTRACTORS' INFORMATION EXCHANGE MEETING
EDITOR OR COMP	HUFFMAN, H.W.; FRALLY, S.K.; REDL, R.J.
ED AFF	COMPS.
PAGE NO	26
CONF TITLE	ERDA-INFORMATION EXCHANGE MEETING FOR THERMAL ENERGY STORAGE PROGRAM
CONF PLACE	GATLINBURG, TN, USA
CONF DATE	25 SEP 1977
DATE	1977
CATEGORIES	EDB-250000;320100
PRIMARY CAT	EDB-250000
REPORT NO	CONF-770955--
ABSTRACT	THE ENCAPSULATION OF PHASE CHANGE MATERIALS (PCM) IN MASONRY OFFERS A METHOD FOR PRODUCING A LOW-COST ENERGY STORAGE SYSTEM WHICH CAN BE MANUFACTURED WITH ONLY SMALL MODIFICATIONS TO EXISTING PROCESSES. IF THERMAL STORAGE IS USED IN CONJUNCTION WITH OTHER SPACE CONDITIONING SYSTEM MODIFICATIONS WHICH PROVIDE INCREASED OVERALL EFFICIENCY OF HEATING AND COOLING DEVICES, THE USE OF IMPROVED THERMAL MANAGEMENT PRACTICES, AND THE OPTIMUM USE OF NATIONAL ELECTRIC GENERATING CAPACITY, NATIONAL SAVINGS THAT SUBSTANTIALLY EXCEED THE ETU EQUIVALENT OF MILLIONS OF BARRELS OF OIL ANNUALLY CAN BE DERIVED. THE MOST EFFICIENT PLACE TO PROVIDE SUBSTANTIAL THERMAL STORAGE IS IN THE STRUCTURE AND COMPONENTS WHICH IMMEDIATELY SURROUND A BUILDING'S OCCUPANTS. THE PROJECT WAS INITIATED IN AUGUST 1977. TO DATE CONCRETE AND CONCRETE POLYMER SPECIMENS HAVE BEEN PREPARED IN WHICH A PCM (CALLSSOD 28 , GMBSOL 280) HAS BEEN USED AS A PARTIAL REPLACEMENT FOR STONE AGGREGATE. EXPERIMENTS TO DETERMINE THE MAXIMUM CONCENTRATION OF PCM THAT CAN BE INCORPORATED INTO THE MATERIALS AND TO DETERMINE THE OPTIMUM PCM CONCENTRATION WITH RESPECT TO THE PROPERTIES OF THE COMPOSITES AND ENERGY STORAGE CHARACTERISTICS ARE COMMENCING.
DESCRIPTORS	BRICKS;BUILDING MATERIALS;BUILDINGS: T2;CONCRETES; ENCAPSULATION: Q1;HEAT STORAGE: Q2;LATENT HEAT STORAGE: T3; PHASE CHANGE MATERIALS: T1;RESEARCH PROGRAMS: Q3;THERMAL ENERGY STORAGE EQUIPMENT;WALLS

TES-7

ACCESSION NO.	77N0100417
TITLE(MONO)	TECHNICAL AND ECONOMIC FEASIBILITY OF THERMAL ENERGY STORAGE. THERMAL ENERGY STORAGE APPLICATION TO THE BRICK/CERAMIC INDUSTRY. FINAL REPORT
EDITOR OR COMP	GLENN, D.R.
CORPORATE AUTH	GENERAL ELECTRIC CO., PHILADELPHIA, PA (USA). SPACE DIV.
PAGE NO	300
AVAILABILITY	DEP. NTIS, PC A13/MF A01.
CONTRACT NO	CONTRACT EY-76-C-02-2558
DATE	OCT 1976
CATEGORIES	EDB-250000;320303;320304
PRIMARY CAT	EDB-250000
REPORT NO	COO--2558-2
ABSTRACT	AN INITIAL PROJECT TO STUDY THE TECHNICAL AND ECONOMIC FEASIBILITY OF THERMAL ENERGY STORAGE (TES) IN THE THREE MAJOR CONSUMER MARKETS, NAMELY, THE RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS IS DESCRIBED. A MAJOR OBJECTIVE OF THE STUDY WAS TO IDENTIFY VIABLE TES APPLICATIONS FROM WHICH A MORE CONCISE STUDY COULD BE LAUNCHED, LEADING TO A CONCEPTUAL DESIGN AND IN-DEPTH VALIDATION OF THE TES ENERGY IMPACTS. THIS REPORT DOCUMENTS ON SUCH PROGRAM. THE BRICK/CERAMIC INDUSTRIES COMMONLY USE PERIODIC KILNS WHICH BY THEIR OPERATING CYCLE REQUIRE TIME-VARIANT ENERGY SUPPLY AND CONSEQUENTLY VARIABLE HEAT REJECTION. THIS APPLICATION WAS ONE OF THE NUMEROUS TES OPPORTUNITIES THAT EMERGED FROM THE FIRST STUDY. NOW AVAILABLE FROM THE ERDA TECHNICAL INFORMATION CENTER, OAK RIDGE, TENNESSEE, IDENTIFIED AS REPORT NO. COO-2558-1.
DESCRIPTORS	BRICKS: T1;CERAMICS: T2;ECONOMICS;FEASIBILITY STUDIES: Q3; PRODUCTION: Q1,Q2;THERMAL ENERGY STORAGE EQUIPMENT: T3;KILNS: Q2

TES-8

ACCESSION NO.	80L0077140
REPORT NO.PAGE	CONF-791232 PP. 316-331
TITLE	DEVELOPMENT OF OPTIMUM PROCESS FOR ELECTRON BEAM CROSS-LINKING OF HIGH DENSITY POLYETHYLENE THERMAL ENERGY STORAGE PELLETS. PROCESS SCALE-UP AND PRODUCTION OF APPLICATION QUANTITIES OF

MATERIAL

AUTHORS SALYER, I.O.
AUTHOR AFF UNIV. OF DAYTON, OH
TITLE(MONO) THERMAL ENERGY STORAGE: FOURTH ANNUAL REVIEW MEETING
PAGE NO 315-331
AVAILABILITY NTIS, PC A99/MF A01.
CONF TITLE THERMAL ENERGY STORAGE REVIEW MEETING
CONF PLACE TYSONS CORNER, VA, USA
CONF DATE 5 DEC 1979
DATE 1979
CATEGORIES EDB-250600
PRIMARY CAT EDB-250600
REPORT NO CONF-791232--
ABSTRACT RESEARCH TO DEVELOP A THERMAL ENERGY STORAGE SYSTEM BASED ON THERMALLY FORM-STABLE PELLETS OF CROSSLINKED HIGH-DENSITY POLYETHYLENE (HDPE) PREPARED BY ELECTRON BEAM (EB) IRRADIATION IS DESCRIBED. THE OPTIMUM EB IRRADIATION CONDITIONS FOR HDPE HAVING THE HIGHEST POSSIBLE HEAT OF FUSION ARE IDENTIFIED. A 250-LB BATCH OF THE OPTIMUM MATERIAL WAS PREPARED AND EVALUATED IN A 12,000-BTU PILOT STORAGE UNIT. A 15,000-LB BATCH WILL BE PREPARED, TESTED, AND DELIVERED TO DOE (ORNL) FOR FULL-SCALE APPLICATION TESTS IN THE FUTURE. TO DATE DUPONT 7040 AND 6 MEGARADS HAVE BEEN SELECTED AS THE OPTIMUM HDPE AND DOSE, RESPECTIVELY. THE 250-LB BATCH HAS BEEN PREPARED.
DESCRIPTORS CROSS-LINKING: 03;ELECTRON BEAMS;IRRADIATION;MATERIALS: 01,02; OPTIMIZATION;PELLETS;POLYETHYLENES: T3;RADIATION DOSES;SENSIBLE HEAT STORAGE: T2,03;THERMAL ENERGY STORAGE EQUIPMENT: T1

TES-9

ACCESSION NO. 80R0061262
TITLE(MONO) ELECTRON BEAM IRRADIATION OF HIGH DENSITY POLYETHYLENE PELLETS FOR THERMAL ENERGY STORAGE. FINAL REPORT OF TASK 1 AND TASK 2, JANUARY 2, 1979-JANUARY 4, 1980
EDITOR OR COMP DAVISON, J.E.; SALYER, I.O.
CORPORATE AUTH DAYTON UNIV., OH (USA). RESEARCH INST.
PAGE NO 69
AVAILABILITY DEP. NTIS, PC A04/MF A01.
CONTRACT NO CONTRACT W-7405-ENG-26
DATE MAY 1980
CATEGORIES EDB-250600
PRIMARY CAT EDB-250600
REPORT NO ORNL/SUB--7601/1
ABSTRACT THE OBJECTIVE OF THIS PROJECT WAS TO DEFINE THE ELECTRON BEAM IRRADIATION CONDITIONS REQUIRED TO PREPARE THERMALLY FORM STABLE HIGH CRYSTALLINITY POLYETHYLENE (HDPE) PELLETS WHICH ARE SUITABLE FOR THERMAL ENERGY STORAGE (TES) APPLICATIONS IN THE TEMPERATURE INTERVAL OF 120°C TO 160°C. THE OPTIMUM MATERIAL AND CONDITIONS FOR ELECTRON BEAM X-LINKING VIA EVALUATION OF THERMAL FORM STABILITY AND RETAINED HEAT OF FUSION OF HDPE PELLETS IN A LABORATORY (5 LB) TES UNIT WAS DEFINED. 250 POUNDS OF CROSSLINKED HDPE PELLETS UNDER THE OPTIMUM CONDITIONS DEFINED IN TASK 1 WERE MANUFACTURED AND EVALUATED FOR STABILITY TO EXTENSIVE THERMOCYCLING IN A PILOT PLANT TES UNIT. FOUR DIFFERENT HDPE SPECIMENS WERE IRRADIATED UNDER DIFFERENT CONDITIONS OF THE TOTAL RADIATION DOSE RECEIVED BY THE PELLETS, THE ELECTRON BEAM ACCELERATING POTENTIAL, THE ELECTRON BEAM CURRENT, THE EFFECT OF INERT ATMOSPHERES DURING IRRADIATION PROCESSING, AND THE EFFECT OF STIRRING THE HDPE PELLETS DURING THE IRRADIATION PROCESSING. THE EXPERIMENTAL VALUES OF THE HEAT OF FUSION AND THE MELTING TEMPERATURE OF THE IRRADIATED HDPE PELLETS WERE MEASURED AND COMPARED TO THE VALUES OF THE AS-RECEIVED PELLETS TO EVALUATE THE EFFECT OF IRRADIATION PROCESSING. THE RESULTS SHOWED THAT HDPE PELLETS IRRADIATED TO A DOSE OF 6 MEGARADS HAVE SUFFICIENT THERMAL STABILITY AND RETAINED HEAT OF FUSION TO BE USED AS TES MATERIAL. THE MANUFACTURE OF 15,000 LB OF CROSS LINKED HDPE PELLETS FOR LARGE-SCALE EVALUATION TES MATERIAL FOR HOME HEATING AND COOLING SYSTEMS IS RECOMMENDED. (LCL)
DESCRIPTORS ELECTRON BEAMS;IRRADIATION;MATERIALS: 02;PELLETS;PERFORMANCE TESTING;POLYETHYLENES: T1;RESEARCH PROGRAMS;SENSIBLE HEAT STORAGE: T2,01;THERMAL CYCLING;THERMAL DEGRADATION;THERMAL ENERGY STORAGE EQUIPMENT

TES-10

ACCESSION NO. 78R0058215
TITLE(MONO) MACRO-ENCAPSULATION OF HEAT STORAGE PHASE-CHANGE MATERIALS FOR USE IN RESIDENTIAL BUILDINGS. FIFTH QUARTERLY PROGRESS REPORT, SEPTEMBER 29, 1977-DECEMBER 29, 1977
EDITOR OR COMP LANE, G.A.; ROSSOW, G.L.; HARTWICK, P.D.; ROSSOW, H.L.
CORPORATE AUTH DOW CHEMICAL CO., MIDLAND, MI (USA)
PAGE NO 34
AVAILABILITY DEP. NTIS, PC A03/MF A01.
CONTRACT NO CONTRACT EY-76-C-02-2917
DATE MAR 1978
CATEGORIES EDB-142000;EDB-140000
PRIMARY CAT EDB-142000
REPORT NO ORO--2917-6
ABSTRACT OBJECTIVES ARE TO ASSESS THE FEASIBILITY OF MACRO-ENCAPSULATED PCM'S FOR RESIDENTIAL SOLAR SYSTEMS, TO DEVELOP AND EVALUATE SUCH MATERIALS. ENCAPSULANT MATERIALS UNDER CONSIDERATION ARE MULTILAYER FLEXIBLE PLASTIC FILMS, STEEL CANS, AND PLASTIC BOTTLES. PCM'S UNDER STUDY ARE Mg(NO3)2 [illegible] STEARIC ACID, Mg(NO3)2 [illegible] A STUDY OF THE STORAGE CAPABILITY OF CaCl2 [illegible] ENCAPSULATED IN POLYETHYLENE BOTTLES HAS BEEN COMPLETED.
DESCRIPTORS AMMONIUM NITRATES;CALCIUM CHLORIDES: T3;ENCAPSULATION: 01; EXPANSION;FLAMMABILITY STEELS;FLUX RATE;HEAT SUBSEQUENT HEAT STORAGE: 03;MAGNESIUM NITRATES;OLIGOMERIC ACIDS;PERFORMANCE TESTING: 02;PHASE CHANGE MATERIALS: T1,02;PLASTICS; POLYETHYLENES;RESIDENTIAL BUILDINGS;SOLAR HEATING SYSTEMS;SOLAR SPACE HEATING;STEELS;THERMAL ENERGY STORAGE EQUIPMENT: T2

TES-11

ACCESSION NO. 79C0129110
REPORT NO./PAGE CONF-790328--P2, PP. 561-592
TITLE ENERGY STORAGE FOR SOLAR AIR CONDITIONING APPLICATIONS UTILIZING A FORM-STABLE, HIGH DENSITY POLYETHYLENE PELLET BED
AUTHORS BOTHAM, R.A.; JENKINS, G.H.; BALL, G.L.; SALYER, I.O.
AUTHOR AFF MONSANTO RESEARCH CORP., DAYTON, OH
TITLE (MONO) PROCEEDINGS OF SOLAR ENERGY STORAGE OPTIONS. VOLUME 1. AN INTENSIVE WORKSHOP ON THERMAL ENERGY STORAGE FOR SOLAR HEATING AND COOLING
PAGE NO 561-592
AVAILABILITY DEP. NTIS, PC A15/MF A01.
CONF TITLE SOLAR ENERGY STORAGE OPTIONS WORKSHOP
CONF PLACE SAN ANTONIO, TX, USA
CONF DATE 19 MAR 1979
DATE 1979
CATEGORIES EDB-142000; 320100
PRIMARY CAT EDB-142000
REPORT NO. CONF-790328--P2
ABSTRACT A PHASE-CHANGE THERMAL-ENERGY-STORAGE (TES) BED MATERIAL, CONSISTING OF FORM-STABLE, CRYSTALLINE, HIGH-DENSITY POLYETHYLENE (HDPE) WAS DEVELOPED BY MONSANTO RESEARCH CORPORATION (MRC), AND ITS UTILITY DEMONSTRATED. HIGH-DENSITY POLYETHYLENE IS A LOW-COST, COMMERCIAL PLASTIC THAT IS PRODUCED IN THE US ON A MULTIBILLION LB/YR SCALE. HDPE HAS A HIGH LATENT HEAT OF FUSION VALUE (NEARLY 50 CAL/G OR 90 BTU/LB), WHICH IS ESSENTIAL FOR IT TO BE USEFUL IN THERMAL ENERGY STORAGE APPLICATIONS OF CONSIDERABLE IMPORTANCE FOR SOLAR COOLING. THE CRYSTALLINE MELTING POINT AND FREEZING POINT OF HDPE ARE IN THE 120 TO 140.5 DEG C (248 TO 284.9 DEG F) TEMPERATURE RANGE MOST SUITED FOR SOLAR ABSORPTION AIR CONDITIONING APPLICATIONS. FURTHERMORE, IT IS INSOLUBLE IN COMMON HEAT TRANSFER LIQUIDS, SUCH AS WATER AND ETHYLENE GLYCOL. THE KEY IN THE DEVELOPMENT OF HDPE AS A USEFUL TES MATERIAL WAS TO RETAIN ITS HIGH HEAT OF FUSION VALUE, WHILE MAKING IT DIMENSIONALLY STABLE WHEN MELTED. THIS WAS DONE BY A CONTROLLED, LIMITED CROSSLINKING (BY EITHER CHEMICAL OR RADIATION CROSSLINKING) OF THE POLYMER CHAINS, THUS RESTRICTING THEIR MOBILITY TO SUCH AN EXTENT THAT THE POLYMER WOULD NOT FLOW IN THE MELT. THE RESULTS OBTAINED FROM A COST-EFFECTIVENESS COMPARISON OF THREE DIFFERENT METHODS OF CROSSLINKING HDPE TO MAKE IT A FORM-STABLE, USEFUL TES MATERIAL ARE PRESENTED. IN ADDITION, THE PROJECTED COSTS OF A PROPOSED HDPE-LIQUID THERMAL TRANSFER SYSTEM ARE COMPARED TO THOSE OF OTHER LIQUID AND AIR THERMAL TRANSFER TES SYSTEMS OPERATIVE IN THE SAME 100 TO 150 DEG C RANGE.
DESCRIPTORS ABSORPTION REFRIGERATION CYCLE; COST; CROSS-LINKING; Q1; ECONOMICS; Q2; HEAT TRANSFER FLUIDS; LATENT HEAT STORAGE: T1; Q1; Q2; MELTING POINTS; PELLETS; PERFORMANCE; POLYETHYLENES: T1; PRODUCTION; SOLAR AIR CONDITIONERS: T2; THERMAL ENERGY STORAGE EQUIPMENT: T3

TES-12

ACCESSION NO. 79J0061416
TITLE CROSSLINKED HDPE MAKES THE GRADE IN THERMAL ENERGY STORAGE
AUTHORS BOTHAM, R.A.; JENKINS, G.H.; BALL, G.L. III; SALYER, I.O.
AUTHOR AFF MONSANTO RES CORP, DAYTON, OHIO
PUB DESC MOD. PLAST., V. 56, NO. 12, PP. 54-56, 58
DATE DEC 1979
CATEGORIES EDB-142000; 360404; 250000; 140901
PRIMARY CAT EDB-142000
AUGMENTATION HIGH DENSITY POLYETHYLENE.
ABSTRACT PHASE-CHANGE MATERIALS HAVING HIGH LATENT HEATS OF FUSION OFFER AN ADVANTAGE OVER SENSIBLE-HEAT-ONLY STORAGE MATERIALS IN TERMS OF THERMAL ENERGY STORAGE (TES) PER UNIT OF VOLUME. HOWEVER, MOST PHASE-CHANGE MATERIALS SUFFER OTHER DRAWBACKS, SUCH AS THE INCONGRUENT MELTING BEHAVIOR OF MANY SALT-HYDRATES AND POOR HEAT TRANSFER IN LARGE BLOCKS OF PARAFFIN WAX. A HIGHLY CRYSTALLINE POLYMER, SUCH AS HIGH DENSITY POLYETHYLENE (HDPE), OFFERS DEFINITE ADVANTAGES AS A POTENTIAL THERMAL ENERGY STORAGE MATERIAL IF IT IS RENDERED FORM-STABLE SO THAT IT DOES NOT FLOW ON MELTING. IT IS DEMONSTRATED THAT A FORM-STABLE CRYSTALLINE HDPE PELLET-BED MATERIAL IS USEFUL IN THE 120-140 DEG C TEMPERATURE RANGE FOR SOLAR-ABSORPTION AIR-CONDITIONING APPLICATIONS. THE SILANE-GRAFTED AND CROSSLINKED RESIN HAS A HIGH HEAT OF FUSION COMBINED WITH EXCELLENT DURABILITY ON CYCLING THROUGH 1000 MELT/FREEZE CYCLES IN ETHYLENE GLYCOL. RESULTS OF A TEST PROGRAM ARE SUMMARIZED AND EXPERIMENTAL DATA ARE TABULATED.
DESCRIPTORS CROSS-LINKING; FUSION HEAT; LATENT HEAT STORAGE: M2,Q4; PHASE CHANGE MATERIALS: M3,Q1,Q2; PHYSICAL PROPERTIES: Q3,Q5; POLYETHYLENES: M3; SOLAR AIR CONDITIONING: M4; TESTING; THERMAL ENERGY STORAGE EQUIPMENT: M1; USES

TES-13

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ABSTRACT	THE PRIMARY OBJECTIVES OF THIS PROGRAM WERE TO DEMONSTRATE: (1) THAT FORM-STABLE HIGH DENSITY POLYETHYLENE (HDPE), WHICH HAS BEEN SHOWN TO HAVE DESIRABLE PROPERTIES AS A PHASE-CHANGE TYPE OF THERMAL ENERGY STORAGE MATERIAL, COULD BE PRODUCED BY PROCESSING IN A POLYETHYLENE PLANT FOR A PROJECTED PRICE NEAR 20 CENTS/LB; AND (2) THAT THE RAW MATERIAL, ETHYLENE, WILL BE AVAILABLE IN THE VERY LONG-TERM FROM ALTERNATE SOURCES (OTHER THAN PETROLEUM AND NATURAL GAS). THESE OBJECTIVES WERE ACCOMPLISHED. PRODUCTION OF USEFUL, FORM-STABLE HDPE PELLETS BY RADIATION CROSS-LINKING WAS DEMONSTRATED. SUCH PELLETS ARE ESTIMATED TO BE OBTAINABLE AT 26 CENTS/LB, USING LARGE-VOLUME (> OR EQUAL TO 10,000,000 LB/YR) IN-PLANT PROCESSING. WELL-DEVELOPED TECHNOLOGIES EXIST FOR OBTAINING ETHYLENE FROM COAL AND PLANT (OR BIOMASS) SOURCES, THUS ASSURING ITS LONG-TERM AVAILABILITY AND THEREFORE THAT OF POLYETHYLENE. A COST-BENEFIT ANALYSIS OF THE HDPE THERMAL ENERGY STORAGE SYSTEM WAS CONDUCTED OVER ITS 120 TO 160°F OPTIMUM OPERATING RANGE WHICH IS MOST SUITED FOR ABSORPTION AIR CONDITIONING. HDPE IS MORE COST EFFECTIVE THAN EITHER ROCKS, ETHYLENE GLYCOL, OR PRESSURIZED WATER AND IS EVEN COMPETITIVE WITH A HYPOTHETICAL 5 CENTS/LB SALT-HYDRATE MELTING IN THIS TEMPERATURE RANGE. THESE RESULTS APPLIED, AS APPROPRIATE, TO BOTH AIR AND LIQUID TRANSFER SYSTEMS.
DESCRIPTORS	ECONOMICS;HEAT STORAGE;LATENT HEAT STORAGE;MATERIALS;PELLETS;POLYETHYLENES;THERMAL ENERGY STORAGE EQUIPMENT

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